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THE NORTH CAROLINA GEOLOGICAL SURVEY

Economic Papers, No. 1

THE
POSSIBILITIES
OF A
MAPLE SUGAR INDUSTRY
IN
WESTERN NORTH CAROLINA

BY

WILLIAM WILLARD ASHE

ASSISTANT IN FORESTRY

WINSTON
M. I. & J. C. STEWART, PUBLIC PRINTERS AND BINDERS
1897

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LETTER OF TRANSMITTAL.

RALEIGH, N. C., June 1st, 1897.

To his Excellency, HON. D. L. RUSSELL,
Governor of North Carolina.

SIR :—I have the honor to submit for publication, as the first of a series of economic papers, a special report on the possibilities of a maple sugar industry in the mountain counties of western North Carolina. In connection with the development of our forest resources, there are a number of lesser industries—the subject of this paper being one of them—the development of which is certain to add materially to the prosperity of our people.

The *Bulletins* now being published by the survey are intended mainly for distribution outside of the state, with a view to attracting capital. The *economic papers*, of which this is the first to be issued, are intended primarily for distribution in North Carolina, with a view to encouraging our own people to protect and develop certain latent resources on their own farms.

Yours obediently,
J. A. HOLMES,
State Geologist.

PREFACE.

There is now made annually in the mountain counties of western North Carolina—especially in Alleghany, Ashe, Watauga and Mitchell—a limited quantity of both syrup and sugar from the sap of the sugar maple or sugartree. Owing to the lack of proper appliances and skill in the making of these materials, both the syrup and sugar are often of inferior quality and sell at low prices; but there is no reason why this should continue to be the case. With the use of proper care and appliances the maple sugar and syrup manufactured from these trees in western North Carolina should be as good as similar products made in New England, and the maple trees in portions of our mountain region are sufficiently numerous to admit of the large expansion of the industry.

Along the slopes of the mountains where the land surfaces are too rugged or steep to permit of the satisfactory cultivation of ordinary crops, less valuable trees might be gradually removed and replaced by maples, which may either be transplanted to such places while small trees, or grown from seed planted for this purpose. In this way a large number of maple trees can in a few years be brought together so as to constitute a "sugar bush" or sugar orchard; and these rugged, southerly mountain slopes, which are now unproductive, can be made to yield an annual income to their owners. Many New England farmers regard the maple sugar grove as the best paying part of their farms.

The aim of this report is two-fold: (1) to give such information concerning the appliances used and methods followed in the manufacture of maple sugar and syrup as will enable persons who desire to make these products in western North Carolina, to do so in the most satisfactory manner; and (2) to show those interested in this subject how they may protect and enlarge the industry by taking better care of the maple trees and increasing the number of these trees either by planting the seed or transplanting young trees, or both. Its object, therefore, is not so much to describe an existing industry as it is to point out how an industry may be developed in our mountain counties; and I trust it may prove of service in that direction.

At the end of the report, which is largely a compilation, will be found a list of the papers consulted and made use of in its preparation, and a list of the dealers in evaporators and other articles used in the manufacture of maple syrup and sugar.

I am indebted to Mr. T. B. Barney, of Underhill, Vt., one of the largest and most successful makers of maple syrup and sugar in this country, for his kindness in reading and revising this paper. He writes me that the greatest essentials to success in this industry are the highest degree of *neatness* and *dispatch* in every part of the process.

J. A. HOLMES.

THE POSSIBILITIES OF A

MAPLE SUGAR INDUSTRY

IN WESTERN NORTH CAROLINA.

BY W. W. ASHE.

SUGAR YIELDING TREES.

The tree, the sap of which is most extensively used for procuring sugar, is usually known as the *sugar maple*, but in the northern states *rock maple* is a common field designation, while in the mountains of North Carolina it is ordinarily called *sugartree.*

The sap of other closely related trees is sometimes used along with that of the sugar maple, the trees being tapped in the same way and the sap mixed, without distinction, with that of the sugar maple. The red maple, striped maple (moosewood or swamp dogwood of the higher mountains), ash-leaf maple (box elder), and, particularly, the white maple yield sweet sap; but there is not so large a proportion of sugar in their sap as in that from the sugar maple, and the running season is shorter, so that fewer runnings can be made before the sap becomes strongly flavored and "buddy" with the early opening of the buds. Although there is no authentic record of the red maple, the most common maple throughout our mountain counties, being tapped for sap in North Carolina, yet it is very largely tapped in Vermont, which is the largest maple sugar producing state; and the sugar made from it cannot be distinguished from that made from the sugar maple.

Dr. Hyram Cutting estimated that nearly one-half of the trees tapped in Vermont are not sugar maples, but are some other species of maples; and in some groves one-half of the trees tapped are red maples. It is probable that red maples will yield sap in the mountainous parts of North Carolina as abundantly as the sugar maples; and where found in groves with sugar maples which are tapped, they should be tapped in the same manner as the sugar maple, and should receive the same care and protection.

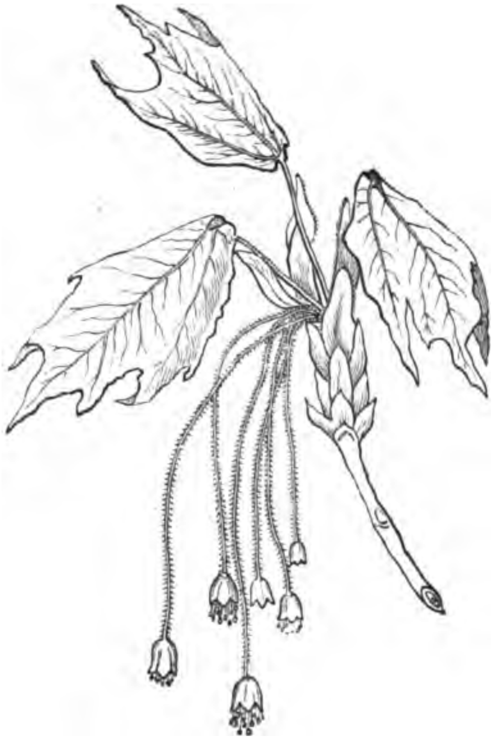


Fig. 1. FLOWERS OF THE SUGAR MAPLE.

HOW TO DISTINGUISH THE MAPLES.

The three maples occurring most abundantly in the mountain counties are to be distinguished from all other trees by having three or five-lobed leaves placed opposite on the twigs, and borne on rather long leafstems, and fruit, hanging in clusters at or near the end of the twigs, consisting of two light, winged seed joined at their base to a common stalk. (See Fig. 2 on next page.)

The sugar maple and the red maple are large trees with furrowed gray bark.

The *sugar maple* has the bark broken into rather large plates, which often hang loosely to the tree. The leaves, as shown in Figure 2, are three-lobed, the lobes three-notched at the ends, and with rounded hollows between the lobes and notches.

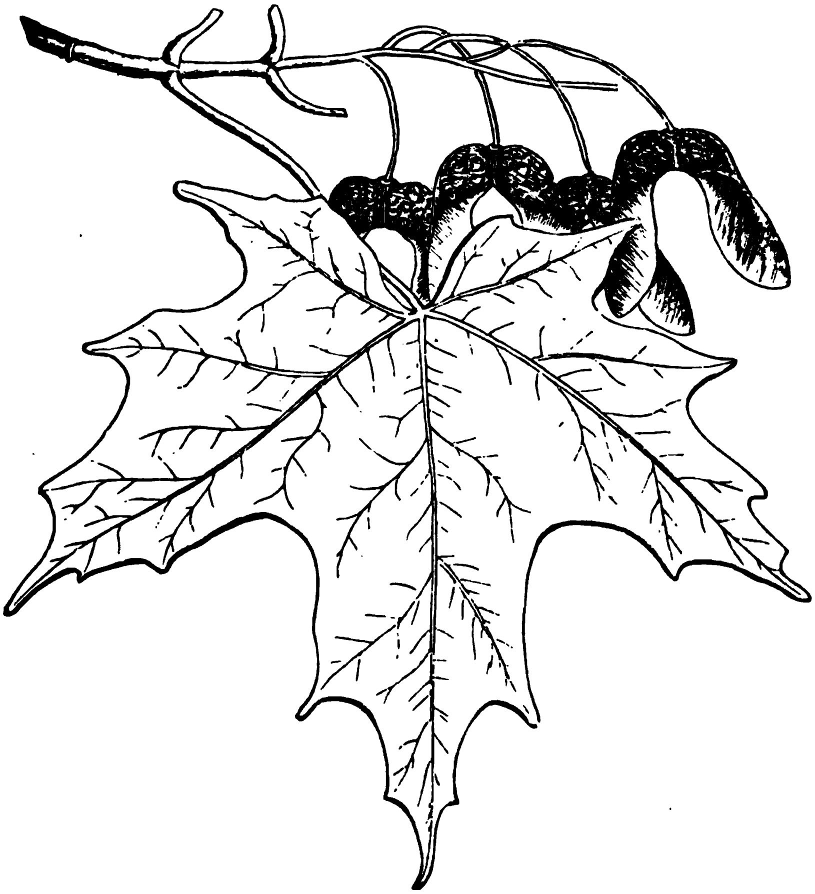


Fig. 2. LEAF AND SEEDS OF THE SUGAR MAPLE.

The twigs are brownish, and the small, sharp-pointed winter-buds are of the same color. The flowers appear in greenish clusters with the leaves, and the fruit ripens late in the fall. (See Figs. 1 and 2.)

The *red maple* has its bark broken into layers looser and narrower than those of the sugar maple. The leaves have three to five sharp-pointed lobes, with sharp hollows between the lobes, and are white on their lower surface. The twigs are frequently bright red, and the conspicuous, round winter-buds are always of that color. The flowers appear in early spring before the leaves, in short, bright red or yellow clusters along the twigs, and the fruit, ripening in July, sprouts at once on falling to the ground.

The *striped maple* or moosewood (or swamp dogwood, as it is called in the higher mountains) is a small tree rarely ten inches in diameter, with a smooth striped bark on both the trunk and branches. The leaves are shaped like those of the red maple, but are larger and are green beneath. The twigs are purplish with a white bloom, and the long winter-buds are borne on stout stalks.

DISTRIBUTION OF THE MAPLES.

Although the sugar maple is frequent throughout the western parts of North Carolina, and eastward as far as Halifax and Wake counties, it is only along the Blue Ridge and to the west of it that it forms extensive groves. To the east of the Blue Ridge it is usually confined to the alluvial bottoms along the streams, generally scattered at intervals among other kinds of trees, or, where the soil and moisture conditions are suitable, forming small groves mixed with a few other species. In most places, however, east of the Blue Ridge the sugar-making season is too short, and warm weather, when labor is in demand for other employment,

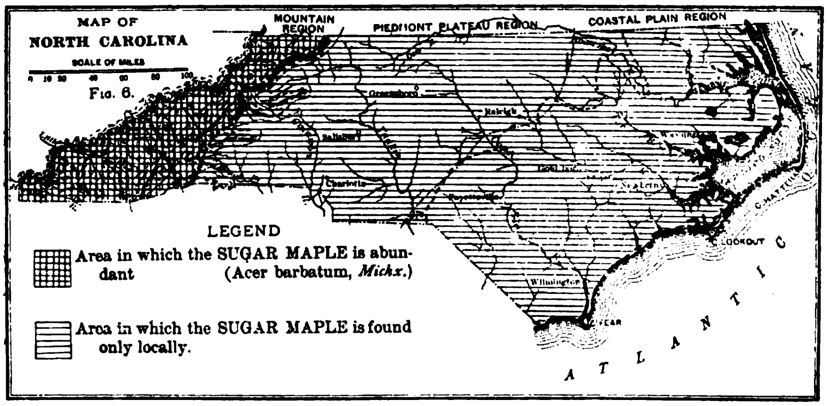


Fig. 6.

begins too soon to offer any inducements for attempting to make sugar or syrup. The tree is most abundant in the extreme northwestern counties, Ashe, Watauga, Mitchell and Yancey, generally growing on the dryer bottom lands or the lower mountain slopes, at altitudes above 3,000 feet; and in similar situations, though less abundantly, it is found as far south as Cherokee county. The red maple has much the same general distribution in western North Carolina as the sugar maple, but is more abundant, especially at the lower elevations. The striped maple is also widely distributed in this region, but is abundant only on the northern slopes of mountains or along streams at elevations above 3,000 feet.

STRUCTURE OF MAPLE WOOD.

The trunk of mature maples, like that of all our common trees, may be separated into four parts: (1) The heartwood, in the

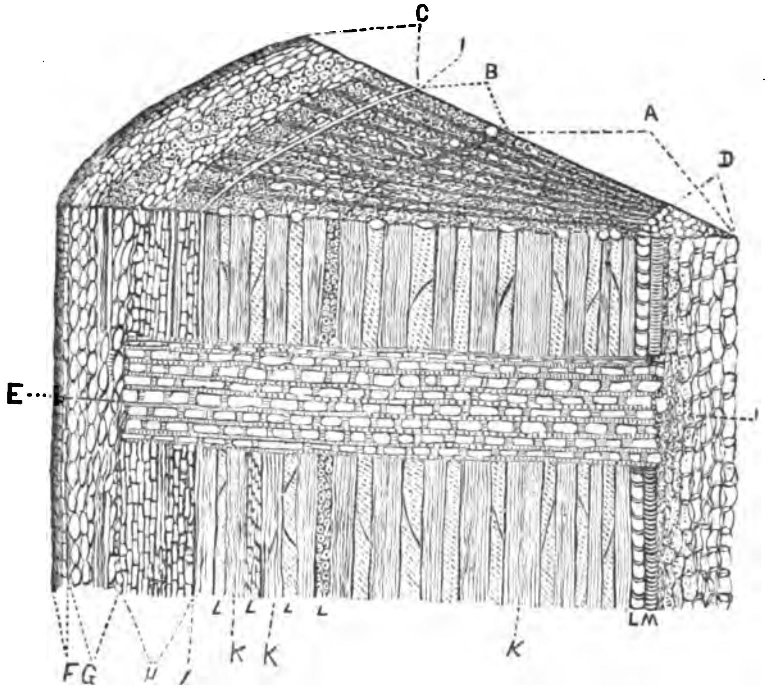


Fig. 3. CROSS-SECTION OF MAPLE TWIG.

D, pith; A and B, woody part of twig; C, growing tissue and bark; F, bark; G and H, growing tissue; E, silver grain; L, ducts in which sap flows; K, strong supporting tissue.

centre of the stem ; (2) the sapwood, forming from 20 to 35 layers of annual growth around the heartwood ; (3) the cambium or growing tissue, a layer of rather soft wood lying just exterior to the sapwood and just within the bark ; and (4) the bark, forming the fourth and outer layer, which merely serves as a protective covering for the rest of the tree.

The cambium (see G and H of Fig. 3) is the seat of the growth of the tree trunk, as it contains all of the growing tissue. Great care should be taken not to injure this cambium in any way, not to separate the bark from it or it from the sapwood, as, in either case, the sap will run in and fill up the crack and will ferment in it. The fermentation will be communicated to the living cambium tissue and will cause its death. The bark will eventually become loosened or fall off, showing that it is a dead spot. Such dead spots heal over very slowly. Sometimes they never heal, and through them different forms of rot enter the trunk of the tree, and destroy the heartwood, and even the sapwood which contains the valuable sap. Fortunately, though, the sugar maple is attacked by few rot-forming diseases, and is such a rapid grower that it quickly grows over small scars and cuts. The red maple is less vigorous and more subject to disease.

DISTRIBUTION OF THE SAP IN THE TREE.

The greater part of the sap in the maple lies in the outer layers of the wood, chiefly in the sapwood, there being little or no moving sap in the heartwood. There is a greater flow of sap also in the outer than in the inner layers of the sapwood, so that a hole which penetrates 2 to 3 inches in the tree will pass through those layers of wood which contain the most sap and are richest in sugar. The greatest flow of sap is always from holes nearest the base of the tree, so that holes should be put as low down as possible.

Although the flow of sap from a wound is chiefly up and down from the longitudinal ducts, it is also to a less extent horizontal, so that, if two holes be bored near together in the same side of the trunk, they will not run as much as if placed on opposite sides for they will draw sap from the same part of the tree; and for a like reason, a hole twice the size of another will not run twice as much sap as the smaller, in fact only a very little more, since each would draw sap from practically the same sized section of the tree.

There is more sap on that side of the tree which has the largest and most limbs, as that is the side which is forming the most new wood and will require the most nourishment. This side of the tree is usually the south side, and is best for tapping as it will yield the greatest amount of sap. Sap on the south side begins to flow earlier than on the north, as the buds on the branches facing the sun expand before those on the north side. Cutting, boring or otherwise wounding trees unnecessarily should always be avoided, as the sap is for the nourishment of the trees, and the loss of it tends to lessen their vitality and make them less vigorous, though trees will stand a great drain of sap if it be carefully taken, without showing an impairment of strength.

TAPPING MAPLE TREES IN NORTH CAROLINA.

The usual way of tapping maple in the mountains of this State is about the same as was practiced in the more northern states up to thirty or forty years ago. An auger hole, one to two inches in diameter, is bored in the tree several inches deep, often 5 or 6. A piece of elder stem of a proper size, with the pith pushed out so as to make a tube of it, is driven in this hole. This spout, after the sap has ceased running, is usually left in the tree until it decays or some accident breaks it off, often thus preventing the hole from healing up for some years. The sap is caught in a rough trough, 18 to 24 inches long and 6 to 8 inches deep, hollowed from a lin (basswood) or yellow poplar log. It is usually boiled down in evaporators, which are found in general use in this section for making sorghum. In general the syrup being carelessly made is of a dark color, and the sugar is also dark, rarely more than 70 per cent. of it being crystallized.

While this practice is cheap and simple in the extreme, it is very injurious to the trees, very wasteful, and produces a product that is salable only at the lowest prices. The chief injury to the tree is in the large hole which takes many years to grow over, the direct exposure of the sap in the hole to the air, so that it frequently sours there, causing the surrounding wood to die and rot, and "killing" a large spot beneath the hole. The wooden spout often goes in beyond the bark, and covers some of the layers of ducts from which sap exudes, and so prevents these from running, thus cutting off a large part of the sap, which chiefly flows from the outer layers of wood.

Another method, still more rough, is to cut with an axe a deep V-shaped notch in the side of the tree. At the bottom of this notch a stout hollowed chip is driven in for a gutter or spout, and this turns the sap into the accustomed wooden trough. Many of these notches never grow over, and great rotten places in the sides of the trees are the result.

HOW AND WHEN TO TAP.

Tapping should be done with an oval-lipped or smooth-cutting bit, as with this there is less danger of injuring the cambium or growing layer beneath the bark. The hole should not be over one-half inch in diameter, while three-eighths inch is the size most Vermont sugar-makers use. Such a hole, if the spout is removed, will grow over in one or, at most, two seasons. The flow from it is very little less than from a hole twice the size, or even larger. It should vary in depth according to the size of the tree, but should not be over 2 inches deep. Holes should be placed near the ground on the side of the tree with the largest limbs. In large trees two holes can very well be placed so near each other that their spouts will empty into the same bucket.

Trees will run sap after the first thaw following the first hard freeze after the leaves have fallen, and can be tapped any time from then on until the buds begin to swell in the spring.

SAP SPOUTS.

Metal spouts have largely taken the place of the hollow wooden spouts, and although they require a considerable outlay at first, yet in saving time and trouble they soon make up for it. They are readily and securely fastened in the holes, and easily drawn out, with little danger of injuring the growing layer beneath the bark. The best forms of spouts prevent the air from reaching the sap in the hole and turning it sour, and keep the sap from drying on the sides of the holes, and so stopping the flow. They are made of galvanized or tinned iron and will last for years.

Two types of metal spouts are to be particularly recommended. One of the "eureka" type (Fig. 4),.and the other of the "record" type (Fig. 5.)

The "eureka" spout, which is the size of the figure, is made of galvanized iron. It is held fast in the tree by a strong cross-shaped projection, which, while it enters the hole for some distance and may go beyond the bark, yet covers up only a few of the ducts from which the sap flows. It has either a hook or notches by which a bucket can be suspended. In order to drive it in so that it will not leak, the bark must be smoothed off around the hole.

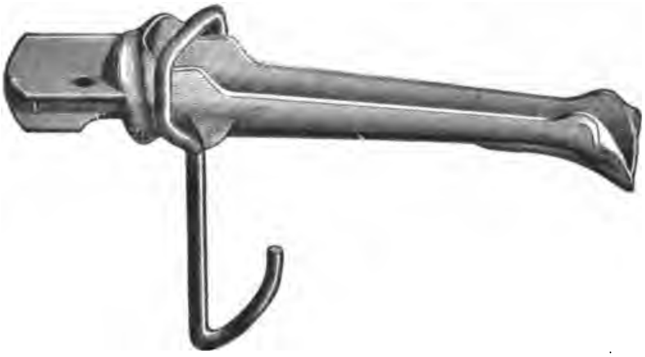


FIG. 4. EUREKA SAP SPOUT.

When the spout is removed before the buds start, the hole will have to be plugged with a wooden plug, otherwise the fermenting sap will sour on the bark, and this acidity will kill a large place upon the tree. If the spout is removed after the leaves start there is no need of plugging, but it should not be taken out too late, else the new wood will have begun to grow over the hole and it will be bruised by tearing the spout out. More than 15,000,000 "eureka" spouts have been sold, and they are in very general use in the northern states wherever maples are tapped. They cost about $2. per 100, or with wire hooks as shown in figure 4, about $2.25 per 100.

The "record" spout costs only about one-half of what the "eureka" spout does. "The body of the spout is made up of two distinct spouts, one being placed inside of the other, then dipped in melted solder which welds the whole into one solid piece. The end that is driven into the tree is closed, with the exception of a small hole through which the sap flows, but which at the same time prevents the air from entering the hole and drying the sap in the tree."

They are not so apt to injure the bark as some other spouts when they are pulled out. The bucket can be hung from them either by a hole in the side of the bucket or from a wire loop hung to the spout.

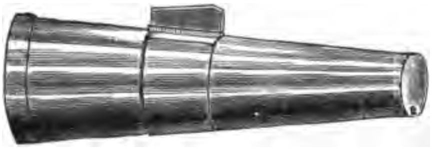


Fig. 5. RECORD SAP SPOUT.

This spout is strengthened by a band around its middle. Both the "eureka" and the "record" sap spouts can be used with buckets hanging from them by the handles, or the buckets can be hung by a hole in the side, in which case a top can be used to keep out the trash. *Under no circumstances should nails ever be driven in a tree from which to hang a bucket.* The sap will leak out around the nail and kill the wood near it.

BUCKETS FOR SAP.

Buckets, suspended from the spouts (see Fig. 7) or from the hooks just below the spouts (see Fig. 4) are now in general use for catching the sap as it runs from the spouts. They are preferably of tin, and should hold about 12 quarts of sap. Sometimes wooden buckets are used. If the buckets are not hung from the spout they should be placed on the ground beneath the spout. *They should never be hung from a nail or iron pin driven in the tree.* They should have a top to them to prevent bark, trash and

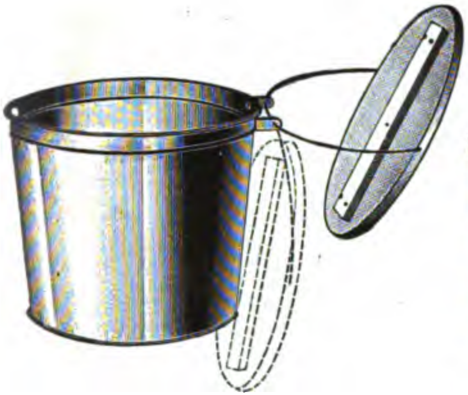


Fig. 6 (*a*). GRIMM SAP PAIL.

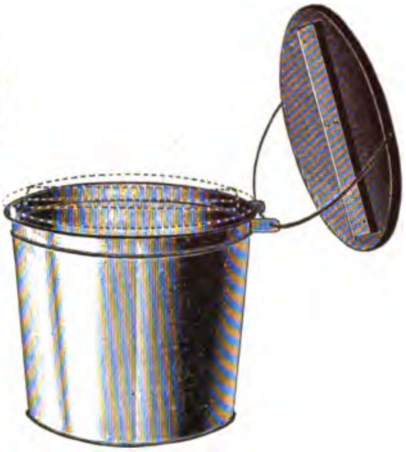


Fig. 6 (*b*). GRIMM SAP-PAIL.

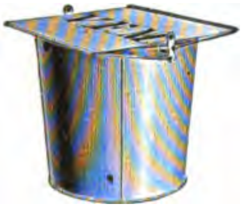
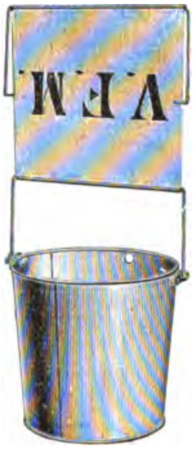


Fig. 6. (*c*) **Cover on Pail.**



(*d*) **Cover Raised on the pail, showing the bail.**

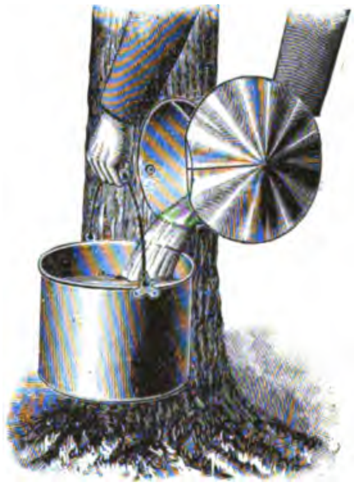


Fig. 7. Cover raised, and cover fastening used as a bail when emptying.

rain water from falling in them (see Fig. 6), as the bark and trash make the syrup darker, and the addition of water requires more boiling in order to reduce the sap to syrup of the right thickness. Good 12-quart tin buckets such as are here described can be purchased at from $14.00 to $16.00 per 100.

COVERS FOR BUCKETS.

Covers are fastened to the buckets in several ways, but the methods of fastening shown in Figs. 6 are so simple that they are to be recommended. Covers, when not bought, and they can probably be much more cheaply made than bought, should be made of some light wood like yellow poplar or white pine. They should be fastened to the bucket so as not to interfere with the sap spouts, and so as to be easily handled when emptying the buckets, and yet so securely fixed to the buckets that they will not be blown off. One of the points of greatest convenience with the covers is that they can be painted different colors on the two sides, so that by having the same color uppermost on all of the buckets, and turning the covers over as the buckets are emptied, the person who is emptying can tell just which buckets have been emptied and which have not. Covers 12 inches square, of white pine boards, can be made at a cost of from $1.25 to $1.75 per 100.

For convenience of packing in the summer, and of transporting to the trees, and from the trees to the packing house, buckets which will nest, that is slip one within the other, are to be preferred. At the beginning of each season, before being hung, buckets should be scalded out, and once, at least, during the running season they should be rescalded. If the weather turns warm at any time, and any of the sap sours in the buckets, these buckets, after being emptied, should be scalded,as that will remove all trace of the souring, and prevent it being communicated to the fresh run.

GATHERING THE SAP.

Sap should be gathered as soon as possible after it has run, as the earlier it is reduced in the evaporator the brighter syrup it will make and the less apt it will be to sour. Cooke thus describes the best method of gathering sap: "If trees are scattered and some distance from the roads the gatherer should carry two pails; but otherwise more rapid work will be done with a single pail.

When we step up to a tree, if we have two pails we set down the one on the ground in the right hand and with this free hand remove the cover and place it under the left arm; then with the right hand grasp the bucket and swing it on the spout and turn the sap into the gathering bucket, which is held in the left hand. The cover is then placed on the bucket with the sides reversed. Thus the bucket is never removed from the spout, and unless we have two gathering buckets nothing is set on the ground." (See Fig. 7, page 19.)

GATHERING TANK.

The gathering tank should be made of metal, and a very complete form of a metal one is shown in figure 8. This consists of a receptacle with two strainers at the top where the sap is poured in, a coarse strainer on the outside and one with finer meshes below it. At the bottom of the tank is a run-off or exit tube by means of which its contents is transferred to the storage tank at the evaporator. A wooden tank or barrel can also be used for collecting, and instead of the metal and felt strainers, a piece of

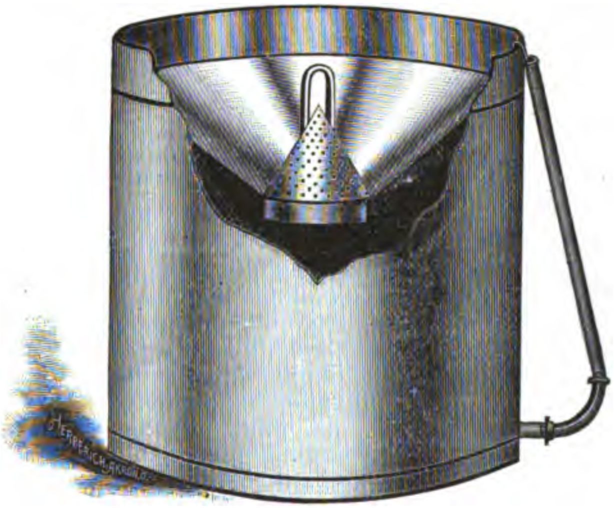


Fig. 8. GRIMM'S SELF-STRAINING AND QUICK-EMPTYING GATHERING TANK.

canton flannel stretched across the top and tacked to the top rim can be used. The sap should always be strained as it is poured from the collecting buckets into the tank, even when covers are used for the sap buckets, to free it from any trash which may have accidentally gotten in. To save time, the collecting tank should always be provided with an exit spout or run-off tube. The tank should be drawn on a sled with a low body so that the buckets of sap can easily be emptied into it, and so that it will be less likely to upset while being drawn along the hill side. These metal hauling tanks hold from 64 to 128 gallons, and cost from $14.00 to $17.00 each. Wooden tanks can be made at a much smaller cost.

THE SUGAR HOUSE.

The sugar house, though not absolutely necessary, is one of the greatest conveniences either where maple products or sorghum is made. Its primary object is to shelter those who are at work around the evaporator during cold and rainy weather, and every evaporator for maple syrup should be placed under a shelter of some sort. In the sugar house is placed the evaporator, which is thus kept out of the rain or snow, and away from trash and dust.

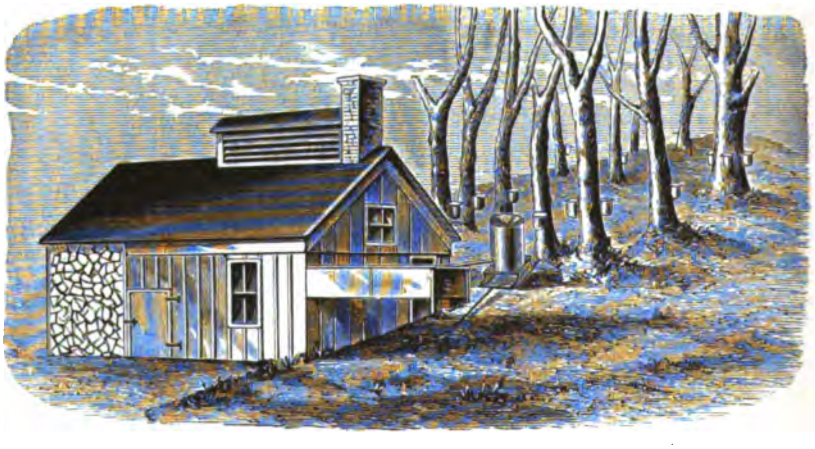


Fig. 9. SUGAR HOUSE.

[Showing the storage tank at the end of the house, and the small cylindrical collecting tank on a sled near by.]

The syrup is here canned, and if sugar is to be made, sugaring off and packing the sugar is done here. Just outside of the sugar house, and preferably on the north and coolest side, should be placed a storage tank for sap. (See Fig. 9.) The sap, as it is brought in from the woods in the collecting tank, should be emptied through the exit pipe into the storage tank. The bed of the wagon road should here be some distance above the bottom of the storage tank so that all of the sap can run from the collecting tank into the storage tank, by means of the exit tube without buckets having to be used. Likewise the bottom of the storage tank should be above the evaporator so that the sap will run from the bottom of the storage tank into the evaporator. The storage tank should be covered and the sap should be strained as it passes from the collecting tank into the storage tank (See Fig. 10). Figure 11 shows an interior arrangement of a sugar house with the storage tank on the inside, the evaporator being a Williams covered evaporator with steam chimney.

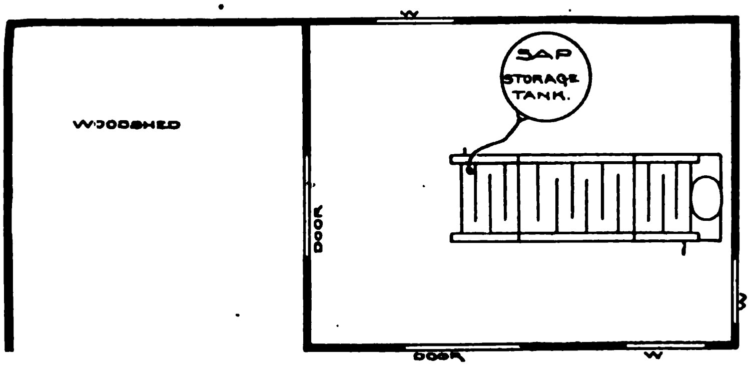


Fig. 10. DIAGRAM OF INTERIOR OF SUGAR HOUSE.

Fuel, which should be cut and piled ready for use some time before, is best kept in a shed or pent house adjoining the evaporator room. It should be under shelter to keep it dry, but if in the same room with the evaporator, the litter and dust from it is likely to get in the evaporator pans.

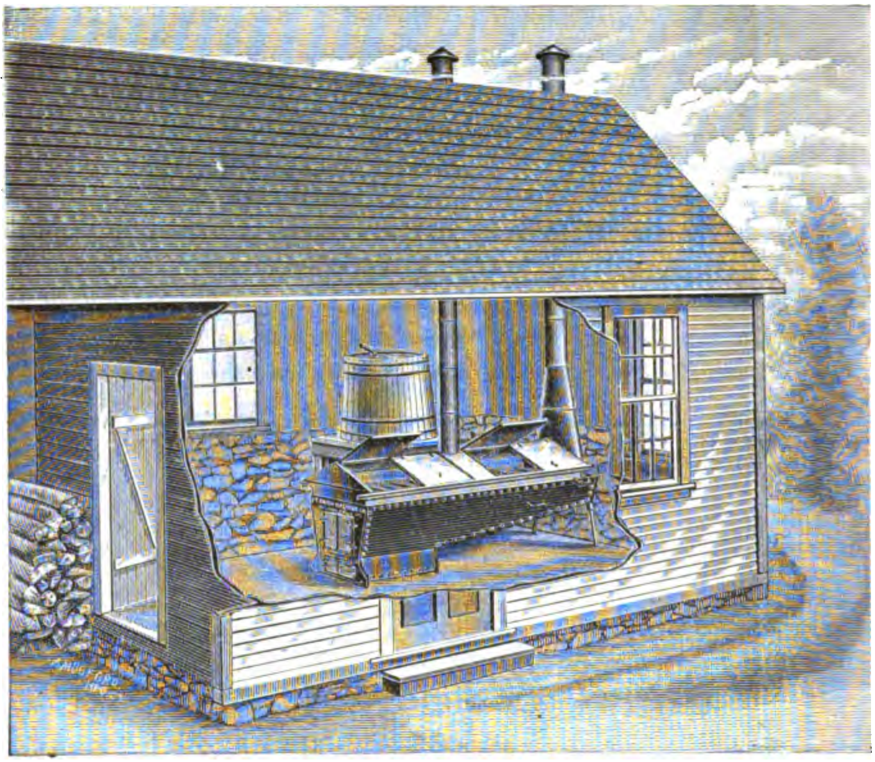


Fig. 11. INTERIOR VIEW OF SUGAR HOUSE.

EVAPORATORS.

Evaporators used for maple syrup are similar to those used for sorghum. They should be placed over stone or metal arches so that a fire can be kept beneath them and a good draught secured, the fuel being put in at one end under the evaporator and the chimney being at the other. Dry wood should be used to give a brisk flame and good heat. As little smoke and dust should be made as possible. The evaporator, no matter what kind, should be set perfectly level, then if the supply of sap flowing in is regulated, there will be no danger of it ever burning. It is customary to have a regulator which, when once set, will regulate the flow of sap from the storage tank into the evaporator. Where large quantities of sap are handled, such a regulator is absolutely

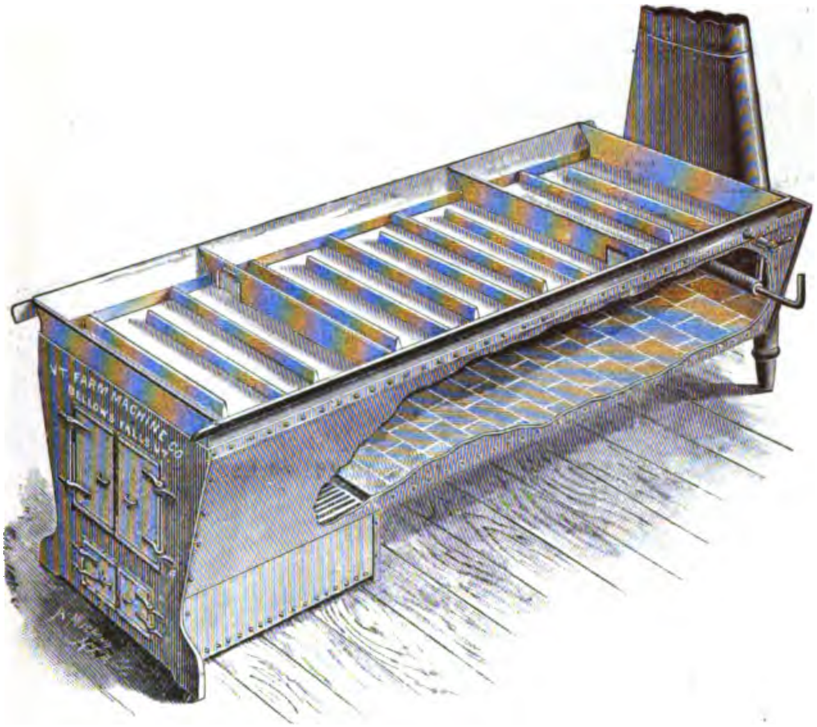

VT. FARM MACHINE CO. BELLOWS FALLS VT.

Fig. 12. WILLIAMS BELLOWS FALLS EVAPORATOR.

necessary. With siphon evaporators such a regulator is indispensable to maintain a uniform supply of sap in the first pan, as the siphon automatically carries it from the first pan into the second. The best forms of evaporators are those with corrugated bottoms, which give a greater heating surface. Siphon evaporators have siphons to convey the sap from one compartment of the evaporator to the other. They are automatic and have the advantage of leaving the scum and sediment in each compartment, and not transferring it to the next compartment along with the syrup.

The Williams Bellows Falls evaporator (Fig. 12) requires no siphon, the sap or half-syrup moving evenly through gates or openings in the partitions. The gates in the cross partitions prevent the movement of the scum from one section to another so that most of it can be skimmed off before the sap becomes syrup.

These evaporators are manufactured by the Vermont Farm Machine Co., Bellows Falls, Vt., in sizes varying from 30 inches by 8 feet, and a capacity of ½ to 1½ barrels of sap per hour, to 40 inches by 18 feet, and a capacity of 6 to 8 barrels of sap per hour, costing, when made of galvanized iron and on portable iron arches, from about $60.00 for the smallest size to $120.00 for the largest size; and without the iron arch costing $20.00 for the smallest to $50.00 for the largest size.

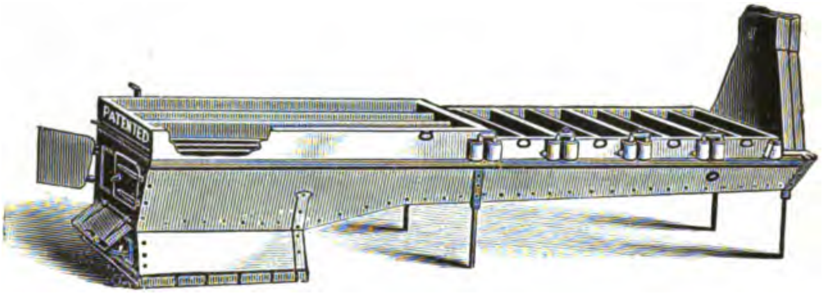


Fig. 13. CHAMPION EVAPORATOR.

The "champion" (Fig. 13) is one of the best siphon evaporators. It is made by the G. H. Grimm Mf'g Co., of Rutland, Vt., and Hudson, Ohio, in several sizes, from 3x8 feet and with capacity for 100 to 150 trees, to 5 by 20 feet, and with capacity for 1400 to 1500 trees.

Regulators are generally used with evaporators to govern the flow of the sap from the storage tank to the evaporator. The "champion" regulator (Figure 14), which is placed in a small pan hung outside the evaporator, regulates the flow by a float, with a lever attached, which rises and closes a valve when the liquid has reached the desired depth.

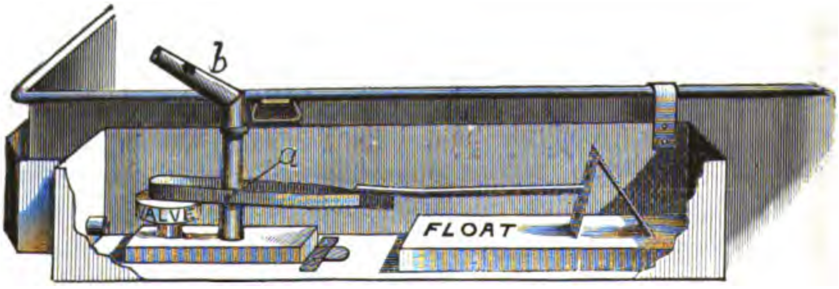


Fig. 14. CHAMPION REGULATOR.

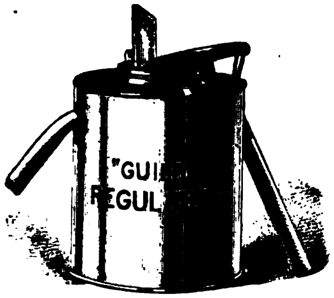


Fig. 15. GUILD REGULATOR.

Figure 15 shows the Guild regulator. "This regulator is set in the front end of the evaporator. A rubber hose, leading from the store tub to the evaporator, is passed through the jaws in the regulator. These jaws are connected to a float which rises and falls as the liquid rises and falls in the pan, opening and closing the jaws as it moves down or up. It never fails to work, if properly set, and is a very great convenience, as it allows the operator to gather sap near by or go to his meals, etc., etc."

With either regulator there is absolutely no fear of burning the pan or syrup, if the store tub (or storage tank) is kept supplied.

MAKING SYRUP.

If the reducing pans are regular evaporators the sap, on beginning, should be turned in to a depth of 1 to 1½ inches, never sufficiently deep to cover the corrugations, and it should be maintained at this depth to prevent any danger of burning. As the syrup boils and become thick it changes from being nearly colorless to a straw color. If syrup is to be made for sale it should weigh about 11 pounds to the gallon when cold. From time to time, after the syrup begins to thicken, a gallon can be drawn off and if it weighs 10½ pounds while hot, it will weigh 11 pounds when cold. A careful observer can soon tell by the appearance, without weighing, when the syrup is thick enough to be drawn off. In open pans where there is no automatic flow, the syrup must be carefully watched lest it become too thick and burn. Iron furnaces are sold to go with some of the evaporators, and these have dampers so that if there is any danger of the syrup burning, the damper can be turned up and the heat cut off.

The hot syrup as it is drawn off must be strained through flannel to remove the malate of lime, "nitre" or "sand" and

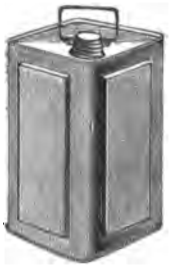


Fig. 16. Syrup can with 1-inch screw cap.

other impurities. It should then, while yet hot, be put in cans (see Figure 16) or quart bottles, which should be tightly sealed while hot. The flannel strainers should be cleaned after each use, and washed after each day's use. Where common pans and not evaporators are used, the syrup should be drawn off three times a day in order to secure a bright colored syrup. Some evaporators must have their bottoms scraped frequently in order to free them from the malate of lime, but in the "champion" evaporator this is prevented from forming by merely regularly shifting the order of the pans. In the improved Williams evaporator the same thing is accomplished by reversing the evaporator and thus causing the current of sap to run in the opposite direction.

The following rules and methods to be observed in making, canning and marketing maple syrup, read by Mr. T. B. Barney before the Vermont Sugar Makers Association at Rutland, Jan. 13th, 1897, are so clear, and have been so highly approved, that they are reprinted here as follows:

Secure, if possible, an orchard with a southerly inclination, a gravelly or clay soil, with fair sized trees, having a lively, light colored bark, and white wood. Procure the very best evaporators, of a size large enough to boil away your sap as fast as it can run. Have the best of buckets, covers, spouts, holders, a small arch and pan for reducing your syrup, and in fact, all of the most improved apparatus for a first-class sugar works.

Have everything neat and clean to commence with, and then be sure to keep them so. Prepare a full stock of wood the year beforehand. A mixture of soft and hard wood is best; the soft wood will produce a quick blaze, while the hard wood will serve to steady the fire, and make it last well. Have the wood well split, do not think you can boil just as well with large logs and chunks; these do not dry through well, and it is the quick, lively fire you want, and not coals in large quantities. There is as much of "nack" in firing an evaporator correctly, as in firing a locomotive so that it will produce a rapid and steady motion.

Tap your trees where the wood is perfectly sound and light colored. Have good buckets with covers well adjusted, so that they will not blow off. They will keep out the storm and particles of bark and other things that would otherwise color the sap, and will pay for themselves in any three average seasons.

Always be on hand in season to gather your sap as soon as it runs. Do not wait for your buckets to get nearly full before you commence. Strain the sap before it goes into the holders. Boil immediately and get into syrup as soon as possible. Strain and settle the syrup thoroughly. Do not mix hot and cold syrup. Guage your regulator so that the sap will be only about one inch in depth in your evaporator while boiling, skim it every few minutes. Boil rapidly and when it comes to ten pounds weight to the gallon, in the last partition of the evaporator, draw it out in small quantities and strain through a good *felt* strainer. When you have a sufficient quantity put it in your small pan and bring it quickly to a temperature of 219° which will make it eleven pounds to the gallon when cold. When it comes to 219° the "nitre" will settle to the bottom of the pan; it should then be stirred up and all put in a good tin settling can having a faucet about two inches from the bottom. Let it stand until cold, then draw off carefully down to the nitre. See that you do not allow any nitre to run out with the syrup.

This completes the necessary rules to be observed in making syrup, and we will now proceed to the canning process. The only safe way to can syrup, if you would have it keep perfectly in any climate[1], is to heat it and mix with it the whites of eggs beaten up in water, (the white of one egg in one-half pint of water for ten gallons of syrup.) When the syrup arrives at the boiling point, *skim* and *strain* it through a good flannel strainer. It is then ready to can and should be put up while hot. The best style of package for a nice retail trade is a solid quart bottle having a screw cap containing a cork. If it is put up for customers who use larger quantities at once, a good heavy tin gallon or half gallon can, well soldered and of the oblong square shape, makes a very nice package.

If one wishes to dispose of his syrup in large quantities without the trouble and expense of canning, it may be put up in good new iron-hooped barrels, holding about 50 gallons, and sold to dealers who make a business of canning for the retail trade.

In order to succeed well in making, canning and marketing your syrup, you must study all these rules and methods carefully, must get them thoroughly fixed in your mind, and then adhere strictly to them. Cleanliness, dispatch and business ability will give you success[2].

MAKING SUGAR.

When the sap has been boiled to such a thickness that it would make a good syrup, it should be poured from the evaporator into the sugar pan and at once reduced to sugar. "Many experienced sugar-makers recommend that the hot syrup be strained through flannel cloth and then allowed to settle until partially cooled before pouring it into the sugar pan, as this settling removes much of the malate of lime from the sugar. In boiling, care must be taken not to burn the syrup. Thick syrup moves sluggishly and hence is liable both to burn and to boil over. A slow fire toward the last is all-important. When the liquid begins to pout, that is, to gather in large air-bubbles, and break with a labored puff—a sort of mild explosion—then it is about ready to be removed." To reduce to "barrel sugar" it should certainly be boiled until the temperature of the boiling liquid is 230° F. When the syrup is about thick enough to sugar it will form, if some of it is dropped from a spoon, delicate threads hanging from the spoon. To make "cake sugar" the syrup should be boiled still longer, until it reaches a temperature of 242° F.; and to make "stirred sugar," longer still, until the temperature is 252° F. In making cake sugar, which is the most desirable for marketing, the syrup is run into moulds (see Fig. 17) and allowed to crystallize out in them; in stirred sugar the syrup is stirred until it cools and crystallizes.

---

[1] This applies to syrup that is to be sent to hot climates, and this egg treatment may be safely omitted for all syrup made for consumption in Western North Carolina, if the sap and syrup have been strained and every thing kept neat, as directed. The main object of adding the white of eggs is to gather together the last vestiges of impurities in the syrup which, along with the egg, can be removed by a final straining just before the syrup comes to the boiling point.

[2] Proceedings of the Fifth Annual Meeting of the Vermont Sugar Makers' Association, held at Rutland, January 13 and 14, 1897.

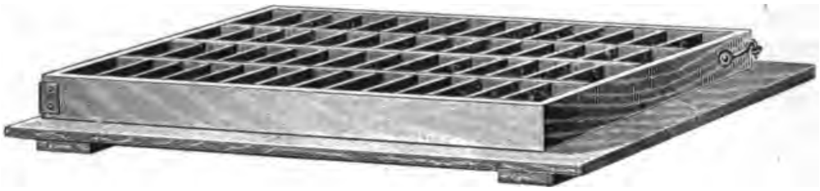


Fig. 17. MOULD FOR MAPLE SUGAR.

Sugar pans or sugaring-off pans, as they are often called, *i. e.*, the pans into which the syrup is poured after having been boiled in the evaporators when it is desired to make sugar, can be obtained from any one of the dealers or manufacturers mentioned on page 34. Those pans made of galvanized iron and adapted for use on a brick arch are priced at about $4.00 for the smaller and about $6.00 for the larger size. Those for use on iron arches, are priced at about $10.00 for the smaller, and $14.00 for the larger size, this including also the additional iron arch necessary for attaching the pan to the evaporator. Special thermometers for determining the temperature to which the syrup shall be boiled for sugar, can be obtained from either of the dealers mentioned on page 20, at from $1.00 to $1.50 each; but any reliable thermometer which will register as high a temperature as is required can be used for this purpose.

PREPARING PRODUCTS FOR MARKET.

The change from the wooden spout and the open kettle has been brought about by the demands of the public for a lighter colored and more uniform class of syrup and sugar than was possible with those implements. In order to make goods of any kind and find profitable sales for them, they must be what the consumers prefer, and must be cleanly prepared and attractively displayed. The use of buckets with covers, and the frequent straining of the sap and syrup, are necessary in order to keep out dust, fragments of leaves, sticks, bark and other impurities, thus to secure light colored products. Unless the products are light colored, it may be supposed that this dust and trash have not been kept out or that the products have in some other way been adulterated, and they will not command so high a price. If, on the other hand, the sugar and syrup have too light a color one may suppose that they have been adulterated by the addition of ordinary white sugar. The cakes of sugar should be light colored and packed in clean boxes. The syrup should be light colored and should be put up in bottles, tin cans, kegs or barrels. What ever vessel is used it must be absolutely clean. (See directions on pages 28 and 29, above.) The maker should in every case have a printed or written label pasted on the bottle or can containing the syrup, or box containing the sugar, giving his name and address, and stating that the syrup or sugar was made by him and is warranted pure.*

Whenever possible, sales should be made directly to the consumers. Syrups are used in large quantities by hotels, and sales can generally be made directly to them. If the syrup is pure and neatly put up, and if the character of the syrup made is kept

*See also Notes on page 29.

uniform each year, there is no reason why a customer once secured should ever be lost. It pays better to make syrup than sugar, as a gallon of syrup as syrup is worth more than if it were reduced to sugar. Syrup retails to the consumer at about 80 cts. a gallon, though some makers claim to realize as much as $1.25 a gallon for all the syrup that they can make. These, however, make an exceedingly light colored, pure and uniform article.

Most Vermont farmers regard the sugar orchard as one of the best paying parts of the farm.

CARE AND ENLARGEMENT OF SUGAR ORCHARDS.

The most fitting place for the location of the sugar orchard, as a grove of tapped maples is called, is where the maples are most abundant and where a great many occur over a small area. If the orchard can be conveniently located near the farm house, so much the better. A hillside sloping southward is the best place, as trees on a slope which faces the sun begin to run earlier in the season and the running of sap each day will be longer, the trees thawing out earlier in the morning and freezing later in the evening. As trees require a number of years to grow, a place should be selected with a view to permanency, if the orchard is to be enlarged by transplanting or from seed. Land that is too rocky to cultivate, or even too steep, can well be stocked with maples; and the orchard can be permanently maintained in such places as there would be no reason for clearing the land.

There are few places in the forest where as many as one-fourth of all the trees will be found to be maples, and, generally, the proportion of maples over any considerable area will be found to be very much less than this; but if such a place is selected where maples are naturally abundant, showing the soil suited for their growth, the number of trees can be largely increased by planting out young specimens or by allowing maple seed to grow where they fall. In either case the trees other than maples must be removed, or at least thinned out, to give the young maples plenty of light. There is very much to be gained by thus concentrating the maples on a small area and increasing the number above what it was in the original forest, as the labor and time involved in going from tree to tree to place the spouts and buckets, and particularly in emptying the buckets and hauling sap to the evaporator, is much lessened; trees, too, are much less apt to be overlooked and passed by than if sparsely scattered among other trees.

To increase the number of trees by transplanting, small maples can be dug up from places where they are found to be numerous and set out in the orchard, and such transplanted trees will, of course, become large enough to tap much sooner than if they were allowed to grow on the spot from seed. Maples when fifteen years old, if the growth has been kept open and there has been sufficient sunlight to enable them to grow vigorously, are large enough to have one small spout put into them. In transplanting trees, vigorous and healthy young trees are to be selected, and it is advisable to plant only sugar maples. They should not be too large, as the cost of handling large trees is very great. They should be dug up, care being taken not to injure the roots and to cut off none where it is not absolutely necessary. In trimming the top, to reduce the limbs to correspond to the reduced number of roots, the leading central shoot should not be cut off, as trees thus mutilated, especially if they are large trees, are apt to have black streaked wood and generally, sooner or later, hollow trunks. Limbs should be smoothly cut off without tearing the bark away from the wood.

Even if all of the trees in the orchard are maples, they should never be crowded, as when far apart they have large heads and an abundant supply of sap. The tops or crowns of the trees should not touch each other, and young trees, as they grow up and their tops begin to interlace, should be thinned out, the smaller and less vigorous specimens being removed.

The evaporator, and the sugar house, if there is one, should be located in the center of the orchard, or as near the center as possible, as the sap will then have to be transported less distance from the trees. If, however, the maple trees of the orchard are distributed over a continuous slope it will be found more convenient to have the sugar house at or near the bottom of the slope.

DEALERS IN OUTFITS FOR MAKING MAPLE PRODUCTS.

Outfits for making maple sugar and maple syrup can be obtained from the Vermont Farm Machine Co., Bellows Falls, Vt.; or from the G. H. Grimm Manufacturing Co., Rutland, Vt.: or the Champion Manufacturing Co., Columbus, O.

LIST OF BOOKS CONSULTED.

Emerson's Trees and Shrubs of Massachusetts.
Bul. 26 Vt. State Ag. Ex. Station, Maple Sugar.
Bul. 30 Vt. State Ag. Ex. Station, Results of bounty on maple sugar.
Maple Sugar, by A. J. Cook; published by A. I. Root, Medina, Ohio. This is an excellent explanation of the best ways to make sugar and syrup, and should be owned and referred to by persons in this State interested in sugar making. It has been largely used in the preparation of this paper. Price by mail, 40 cts.
Goodale, Physiological Botany.
Rept. of Mass. Board of Agr., 1874.
Proc. of A. A. A. Science, 1879.
Bul. 5 of the Chemical Div. of Vt. Dept. of Agr.
Trans. of Royal Soc. of Can., Vol. V., Sec. III. (1887).
André, in Revue Horticole, 1886, p. 284.
Studies of Maple Sap, Bul. 2, N. H. Agr. Ex. Station.
Bul. 25, N. H. Agr. Ex. Station.
Several articles in Garden and Forest, New York.
Publications of Vt. Maple Sugar Maker's Asso.
Forests of Vt., H. A. Cutting.
Catalogue of Vt. Farm Machine Co., Bellows Falls, Vt.
Catalogue of the G. H. Grimm Mfg. Co., Rutland, Vt.. and Hudson, Ohio.

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2. Building Stone in North Carolina, by Joseph A. Holmes and J. Volney Lewis.......In preparation.

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4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp.......Out of print.

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13. Clay Deposits and Clay Industries in North Carolina, by Joseph A. Holmes and Heinrich Reis.......In preparation.

14. Mica Deposits and Mica Mining in North Carolina, by Joseph A. Holmes.......In preparation.

15. Mineral Waters of North Carolina, by F. P. Venable.......In preparation.

16. A List of Elevations in North Carolina, by Joseph A. Holmes.......In preparation.

17. Historical Sketch of North Carolina Scientific and Economic Surveys; and Bibliography of North Carolina Geology and Mineralogy, by Joseph A. Holmes.......In preparation.

18. Road Improvement in North Carolina, by J. A. Holmes and Wm. Cain.......In press.

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NORTH CAROLINA GEOLOGICAL SURVEY

Economic Papers, No. 2

SOME
RECENT ROAD LEGISLATION
IN
NORTH CAROLINA.

J. A. HOLMES

The result of one hundred years of road building under the old system of compulsory labor. Isn't it about time to try a different system?

PUBLIC PRINTER, RALEIGH.
1899

The old fashion earth road may be the cheapest road to build but it is the most expensive road to use. In using them we lose more than it would cost to build good roads.

The people of Mecelenburg invested during 1898 over $30,000 in these good roads, and they say this is the best paying investment the county ever made.

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LETTER OF TRANSMITTAL.

To his Excellency, Hon. D. L. Russell,
Governor of North Carolina.

Sir:—In response to a somewhat general demand for the same I have the honor to submit for publication, as the second of a series of *economic papers*, a brief account of some recent legislation in North Carolina providing for the maintenance and improvement of the public roads and highways in certain counties in the State.

Yours obediently,
J. A. Holmes,
State Geologist.

BOARD OF MANAGERS.

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PREFACE.

Many a legislator has returned to his home with the feeling that having passed a new road law for his county the securing of good roads is only a matter of a short time. But during the next few years he has seen his law either repealed or amended, for better or worse, by succeeding legislatures; and meanwhile little or nothing has been accomplished in the way of improvements of a permanent character. But the very rapidity with which local road legislation has changed in North Carolina during the past decade of itself indicates in a measure the deep interest felt by our people in this subject.

There are many people who seem to think that a good road law will make good roads; but we all realize after a short experience that this will be true only when such a law is supported and executed by an intelligent and progressive public opinion and action. In a community guided by such a sentiment there is needed only a law which, in the simplest possible way, gives the proper authorities the power to do what is right and necessary in this connection.

The general road law of 1899 published in this paper is not the product of any one person. It was prepared by and under the direction of the public roads committee of the last General Assembly. It is based on the experience of the best road builders in the state and a careful digest of existing road laws in this and other states. Not one of its authors supposes it to be perfect or that the law of itself will build good roads; or that it will please everybody; for there are many people who do not like any law which levies a tax and says "thou shalt" do even what they know must be done. But it is believed that a careful examination and test of this law will show it to be greatly helpful in any county or township where the people have determined to permanently improve their public roads whether they be located among the mountains or nearer the sea shore. In Bulletin 18 of the Geological Survey series of reports will be found a fuller discussion of road legislation in North Carolina during the past century, and also a description of the modern methods of road building.

SOME RECENT ROAD LEGISLATION IN NORTH CAROLINA.

LAWS OF A GENERAL NATURE.

Among the laws in relation to road building in North Carolina enacted by the last Legislature there are a few of a somewhat general nature which owing to the new features which they embody or to their general application deserve to be mentioned in this connection. Of these the general road law, which is published in full below (p. 11), applies directly to only a limited number of counties; but any of its sections except that levying a tax may be adopted by any county otherwise providing funds for road improvement. The wide-tire law, the object of which is to encourage the use of wide tires on wagons and other draft vehicles, applying to eleven counties and one township, is also published in full below (p. 24). Two general acts relative to public prisoners were passed: one authorizing the Commissioners in the several counties to provide for working all short term prisoners on the public roads or on county farm; the other, "An act to compel vagrants to work on public roads or highways of the State." Another act provides that persons having gates on public roads shall provide hitch-posts on either side of the gate.

SPECIAL OR LOCAL ROAD LAWS.

A considerable number of local laws were enacted bearing on the subject of road and street improvements in different counties and towns. Five counties and one township were authorized to vote during the present year on the issue of bonds for road purposes: Alamance, Cabarrus and Mecklenburg, for $100,000 each; New Hanover, for $50,000, and Anson for $25,000; Monroe township (Union county), $30,000; and several other counties were authorized to issue bonds for the building of bridges. Beside these, some half dozen towns were authorized to vote bonds for street improvement.

New special road laws were enacted for Anson, Washington, New Hanover, Cumberland, Davidson and Polk; special laws relative to the use of convicts were passed for Franklin, Chatham, Robeson and perhaps a few other counties; the existing laws with reference to the working of convicts on the roads in Anson county and the working of public roads in Graham, Transylvania, Jackson, Guilford, Haywood, Mecklenburg and Wake were amended; while special laws for Northampton, Green, Wilson, Wayne, Nash, Halifax, Jones, Ashe, Alleghany and Watauga were repealed. In addition to the above a number of special laws were enacted with reference to the construction of bridges, ferries and turnpikes in various counties.

THE GENERAL ROAD LAW OF 1899.

The Mecklenburg road law, which was the beginning of modern road legislation in North Carolina, was drawn by Capt. S. B. Alexander of Charlotte as a general road law, but was adopted by the General Assembly of 1879 for only 3 counties, Mecklenburg, Forsyth and Stokes. It was repealed by the following Legislature (1881) for each of these counties. It was re-enacted by the General Assembly of 1885, in a somewhat modified form, for Mecklenburg county alone. Since that time it has entered largely into the road legislation for various counties. Indeed this has exercised a lasting influence for good on the road legislation of the state. The general road law of 1899 is intended to serve either as a supplement to this Mecklenburg law or as a substitute for it. It is more especially a county system of road management, while the Mecklenburg law is more especially a township system. It may be made to serve as a substitute for both this Mecklenburg township system and for the general convict law, under the latter of which in Mecklenburg county that splendid system of Macadam roads has been constructed during the past few years.

PRINCIPAL FEATURES OF THE LAW.

The principal features of this law of 1899 may be stated as follows:

Section 1 provides for a tax levy for road purposes by the County Commissioners of not less than 5 nor more than 25 cents on the $100 worth of property, nor less than 15 nor more than 75 cents on the poll, the funds arising from this tax to be used as far as possible for permanent improvements.

Sections 2 and 3 provide for the appointment of either a superintendent of roads, or township road supervisors, or both, to take charge of the road work under the County Commissioners.

Sections 4, 5, 6, and 7 provide for the repairs or patching of public roads by able bodied male citizens between the ages of 21 and 45 years, four days labor or the payment of $2 for each man.

Section 18 empowers the Board of Commissioners to gradually reduce the number of days of labor required for road duty, one day for each year, until the old labor system is abolished entirely, the road tax being increased proportionally; while Section 19 empowers the Commissioners to reduce the payment in lieu of this labor from $2 to $1 per annum when a sufficiently high tax is levied.

Sections 8 and 9 provide that any county shall work on its poblic roads all its prisoners whose sentence does not exceed 10 years; and that it may also use similar prisoners from other counties in the same or adjoining judicial districts; also that counties with but few convicts may arrange for an exchange with neighboring counties.

Sections 10 and 12 provide for the proper grade, width and relocation of important public roads or highways. In changing the location of roads to avoid hills, etc., the location of the road is first changed; and if after the new road is completed damages are claimed the benefits and damages are both considered by an impartial jury and settlement made on this basis. Section 10 recognizes and separates these principal public roads or highways which are to receive this special treatment from the less important roads which may receive less careful attention; the selections to be made by the county commissioners.

Section 11 provides for obtaining timber, stone, gravel, etc., from unimproved lands adjacent to the roads.

Sections 15 and 16 make the county treasurer also treasurer of road funds and provides for the disbursement of these funds.

Section 20 provides that counties levying bonds for road purposes need not levy a road tax in addition.

Section 21 provides that any township may by a majority vote or petition have levied a township road tax in addition to the county road tax.

Section 22 makes this act apply to the following counties: Mecklenburg and Forsyth (except sections 4, 5, 6 and 7); Alamance, Durham, Rockingham, Gaston, New Hanover, Pender, Warren, and Chapel Hill township of Orange county.

Section 23 provides that this act may be adopted as the road law for 39 additional counties or any township therein by the Board of Commissioners, when petitioned so to do by 300 freeholders in the county or 50 freeholders in any township.

Sections 24, 25 and 26 relate to Durham, Pender and Orange (Chapel Hill township) counties respectively.

Section 27 provides that in any county not coming under the provisions of this act but otherwise providing funds for improving its roads, the Commissioners may nevertheless adopt as a part of the road law of their county any sections of this act except Section 1, levying a tax. In this wav this new road law may be in part adopted by every county which is earnestly trying to improve its public roads.

Section 28 repeals all laws or parts of laws in conflict with this act and Section 29 makes this act in force March 7, 1899.

A careful examination of this law will show that it is in a measure both flexible and rigid, and hence that it can be easily adapted to the varying conditions which exist in different portions of the State.

COUNTIES TO WHICH THE ABOVE LAW APPLIES.

As will be seen from an examination of section 22, the general road law of 1899 is made to apply directly to nine counties and one township. Section 23 states the conditions under which this law may be adopted for thirty-nine additional counties.

Section 27 gives a list of counties to which the law does not apply but also provides that any or all portions of the law (except section 1 levying a tax) may by a vote of the county commissioners be incorporated as a part of the road law of any county in the state otherwise providing funds for road improvement. In this way it is possible for the best features of this law to be adopted by every county in the state which is making a serious effort to improve its public roads.

AN ACT TO PROVIDE FOR THE BETTER WORKING OF THE PUBLIC ROADS AND HIGHWAYS OF THE STATE.

The General Assembly of North Carolina do enact:

SECTION 1. That the board of county commissioners in each of the several counties coming under the provisions of this act, shall, in order to provide for the proper construction, improvement and maintenance of the public roads of the county, at their regular meeting in June, 1899, and at each regular annual meeting thereafter, and it is hereby made their duty to levy a special tax on all property subject to taxation under the State law in said county of not less than 5 cents, nor greater than 25 cents on the $100 worth of property, and not less than 15 cents nor greater than 75 cents on the poll; the constitutional equation to be observed at all times; said taxes to be collected as all other taxes are, to be kept separate in the tax books of the county, to be set aside as a special road fund to be used in the construction, improvement and maintenance of the public roads of the county, the purchase of such material, implements, teams, wagons, camp outfit, quarters or stockades, for the use of and safe keeping of the convict force as may be found necessary in the proper carrying out of this work, and for the employment of such additional labor as may be deemed necessary: *Provided, however*, that the moneys raised under this section shall, as far as possible, be used for permanent improvements.

Provision for a road fund.

Money to be spent for permanent improvements.

SEC. 2. That there shall hereafter be elected by the board of county commissioners at their regular meeting in June, 1899, and at their regular meeting in January of each and every year thereafter, a superintendent of roads, who shall be paid such compensation as may be fixed by the board of county commissioners, and to be paid out of the county road fund, and who, after January, 1899, shall hold office for one year, or until his successor has been elected and qualified, as provided for in this act: *Provided*, that the said superintendent of roads may be at any time removed by the board of county commissioners after having been given ten days' notice and a hearing, when in the opinion of the board there exists good and sufficient cause for such action; and for malfeasance or misconduct in office he may be removed by them without further notice than may be necessary in order to give him a hearing. It shall be the duty of said superintendent of roads, subject to the approval of the board of county commissioners, to supervise, direct and have charge of the maintenance and building of all public roads in the county, and he shall submit to the board of county commissioners a monthly report concerning the work in progress and the moneys expended; and he shall submit quarterly a report on the condition of the public roads and bridges, and plans for their improvements, and he shall include in this quarterly report an inventory of the tools, implements, teams and other equipments on hand. Said road superintendent, before entering upon the duties of his office, shall deposit with the board of county commissioners a good and lawful bond, to be approved by the said board of commissioners, for the sum of $2,000 as a guarantee of the faithful and honest discharge of the duties of

Constant and responsible oversight of roads.

Bond of the road superintendent.

his office, which bond shall be duly registered in the office of the register of deeds and filed with the clerk of the superior court of the county. In case of the death or resignation or removal of said road superintendent, it shall be the duty of the county commissioners to elect at their first meeting thereafter a road superintendent, who shall hold office at the discretion of said board of county commissioners, or until the regular January meeting of said board, and until his successor has been elected and qualified: *Provided*, that when in the opinion of the board of commissioners in any county coming under the provisions of this act, not regularly employing a convict force on its public roads, the appointment of a road superintendent is inconsistent with the best interests of such county, the said board shall not be required to comply with the requirements of section 2 of this act, but may, in lieu thereof, appoint directly one supervisor of roads in each township, and each such supervisor, in the township for which he is appointed, shall perform the duties and assume the responsibilities in this act otherwise required of the county road superintendent; he shall be subject to dismission under the same terms as laid down for the road superintendent; and he shall give a good and lawful bond, satisfactory to the board of commissioners, for not less than twice the amount of the road tax in his township for any one year, under the same conditions as laid down for said road superintendent, and he shall be paid such remuneration as may be agreed upon by the board of county commissioners.

Appointment of township supervisors.

SEC. 3. That the board of county commissioners, or the road superintendent, subject to the approval of said board, shall appoint, with power at any time to remove or discontinue, such guards as may be needed to take charge of the convict force, and also one or more persons in each township of the county, to be known as township supervisor of roads, who, acting under the road superintendent, shall supervise the road work in the township for which they are appointed, or such parts thereof as said superintendent may direct. The said guards and township supervisors shall be paid for such time as they may be required to give to this work, such compensation, per day, during such time as they are actually employed in working on the public roads as may be agreed upon by said [road] superintendent, and approved by the board of county commissioners, the guards to be paid out of the general county road fund, and the township supervisors to be paid out of the respective township road funds.

Temporary township supervisors.

SEC. 4. That all able-bodied male persons of the county, between the ages of twenty-one and forty-five years, except [residents] of incorporated cities and towns, shall work on the public roads of said county for four days (of nine hours each) in each and every year at such time and place, and in such manner as may be designated by the road superintendent or township supervisor: *Provided*, that the said superintendent or the supervisor in each township shall give to each person of his township, who is subject to road duty, at least three days' notice by personal warning, or by leaving a written notice at the home or residence of such person, specifying in such notice the time and place when and where such work is to be performed, and also designating in such notice the tool or implement with which such person shall be required to work: *Provided*

Four days labor for repairing roads in each township.

further, that in case of washout or other unexpected obstruction to travel the three days' notice shall not be neccessary, and any person liable to road duty in the township in which such obstruction to travel may occur, shall, upon being properly summoned by said superintendent or supervisor of roads, respond to such summons with reasonable promptness: *Provided*, *further*, that any person may, in lieu of working four days on the public road, pay on or before the first day of July, 1899, and on or before the 1st day of April of each year thereafter, to the county treasurer or road superintendent, the sum of two dollars, and it shall be the duty of said treasurer or road superintendent, upon receipt of said money, or any part thereof, to issue to such person a receipt for the same, stating in such receipt the amount and the year for which the same is paid. All moneys paid to the said road superintendent, as provided for in this act, shall, within fifteen days after being received by him, be turned over to the county treasurer and credited to the road fund of the township from which the same was paid, and the same shall be expended in the improvement of the roads in that township from which it was paid. If the road superintendent fail to turn over to the county treasurer money so collected, within fifteen days, he shall be guilty of a misdemeanor: *Provided* that no person liable to road duty under this section shall be required to work on the public roads outside of the township and road district in which he resides, the boundaries of the road districts within each township to be fixed by the county commissioners.

Labor or money paid in lieu thereof to be used in separate townships.

SEC. 5. That any person who shall, after being duly notified as provided in section 4 of this act, fail to appear and work as required to do, (after having failed to pay the sum of two dollars) or any person who shall appear as notified, and fail or refuse to perform good and reasonable labor as required by the said superintendent or supervisor, shall be guilty of a misdemeanor, and upon conviction shall be fined not less than two nor more than five dollars, or sentenced to work on the public roads of the county for not less than ten nor more than twenty days.

Tools and implements.

SEC. 6. That proper implements and tools for use in working the public roads of the county, as provided in section four of this act, may be supplied by the county road superintendent, and shall be paid for out of the road fund of the townships in which the said implements or tools are to be used: *Provided*, that until the county road superintendent shall be able to supply the necessary implements and tools, he may, and is hereby empowered to compel any and all persons working on the public roads of the county to provide themselves with such implements as are commonly used, while working on said road, as the superintendent or supervisor may designate in his notice or summons as being necessary.

Preparation of a list of persons liable for road duty.

SEC. 7. That on the first day of June, 1899, and on the first day of April of each succeeding year, or oftener if required to do so by said superintendent of roads, the township supervisor of roads in each township of the county shall furnish through the county road superintendent to the treasurer of the county a complete list of the names of all persons liable for road duty in the township in which he resides. Said treasurer of the county, after receiving the above list of persons liable for road duty, shall check off the names of such persons as have paid the sum of two dollars as provided in section 4 of this act, and shall, within fifteen days, and as often thereafter as may be necessary, furnish to the county road superintendent a correct revised list of all persons liable for road duty in each said township for the year. A list of such persons liable to road duty in each township, who have during the year failed to work on the public road, after having been duly notified, or to pay as provided for in section 4 of this act, shall immediately be submitted by the county road superintendent or township supervisor to a justice of the peace in the township in which such persons reside, and it shall be the duty of said justice of the peace to immediately issue his warrant for such persons and proceed against them according to law: *Provided, however*, that the defaulting party may be prosecuted at any time and by any citizen of the county.

Penalty for failure to work.

SEC. 8 That all prisoners confined in the county jail, under a final sentence of the court for crime, or imprisonment for non-payment of costs or fines, or under final judgment in cases of bastardy, or under the vagrant acts, all insolvents who shall be imprisoned by any court in said county for non payment of costs, and all persons sentenced in said county to the state prison for a term of less than ten years, shall be worked on the public roads of the county: *Provided*, that [in case the number of such prisoners in any county, at any time, be less than five] the commissioners of the county may arrange with the commissioners of any neighboring county or counties for such an exchange of prisoners, during alternate months or years, as will enable each such cooperating county to thereby increase the number of prisoners at work on its public roads at any given time. And upon application of the said road superintendent of the county, or that of the chairman of the board of county commissioners, the judge of the superior court, or the judge of the criminal court, the justices of the peace and the principal officer of any municipal or any other inferior court, it shall be the duty of the said judge or justice of the peace, or said principal officer, to assign such persons convicted in his court to said road superintendent, for work on the public roads of said county; all such convicts to be fed, clothed, and otherwise cared for, at the expense of the county: *Provided, further*, that in case of serious physical disability, certified to by the county physician, persons convicted in said superior, criminal or inferior courts in the county may be sentenced to the penitentiary or to the county jail.

To work convicts on the rounty roads.

SEC. 9. That when the commissioners of any county shall have made provisions for the expense of supporting and guarding, while at work on the public roads, a larger number of prisoners than can be supplied from that county, upon the application of the commissioners of said county to the judges of the superior and criminal courts presiding in adjoining counties, or any other county or counties in the same or adjoining judicial districts, which do not otherwise provide for the working of their own convicts on their own public roads, may sentence such able-bodied male prisoners as are described in section 8 of this act from such adjoining counties or other counties in the same and adjoining judicial districts to work on the public roads of said county or counties applying for the same, in the order of their application; and the cost of transporting, guarding and maintaining such prisoners as may be sent to any such county applying for the same, shall be paid by the county applying for and receiving them out of the road fund of each such county: *Provided*,

Obtaining convicts from other counties.

hat any and all such prisoners from such other counties may at any time e returned to the keeper of the common jail of such counties, at the exense of the county having received and used them.

SEC. 10. That the principal public roads or highways to be improved r constructed in accordance with the provisions of section 1 of this act, rior to the inauguration of any such permanent improvements on the oad or highway to be so improved or constructed, may be first carefully urveyed and located by an engineer or surveyor, trained and experienced n such work, aided by the county road superintendent and such assistnts as it may be necessary for him to employ, the same to be paid out f the road fund of the county, for services and expenses as may be greed upon by the county commissioners. All such public roads or ighways where changed or hereafter located or relocated, shall be given grade nowhere greater than three feet in one hundred feet, in counties ituated in eastern North Carolina; five feet in one hundred feet, for ounties situated in middle or Piedmont North Carolina; and six feet in ne hundred feet in counties situated in the mountain region of the State, nd a width of not less than twenty feet, clear of ditches, trees, logs, and ther obstructions. All such roads shall be thoroughly drained, and vherever it may be necessary to turn water across the road this shall be lone by putting in sewer pipe or other forms of covered drains or culverts: *Provided*, that where, in the opinion of an experienced and cometent engineer, insurmountable obstructions make the grades just decribed impracticable, the grades may be increased to the extent of one oot in one hundred in either of the regions named in this section, for listances of less than fifty feet in one place: *Provided, further* that vhere the roadway must be located on the steep slope of a mountain, its vidth shall not be less than sixteen feet between ditches, or where lasted out in hard rock the width of such roadway shall be not less than hirteen feet.

Regulating the grade and width of more important roads or highways.

SEC. 11. That for the purpose of carrying out the provisions of this act, he said superintendent and supervisors are hereby authorized to enter pon any uncultivated lands, near to or adjoining such roads, to cut and arry away timber, except trees or groves on improved lands planted or eft for ornament or shade, to dig, or cause to be dug and carried away ny gravel, sand, clay or stone which may be necessary to construct, imrove or repair said road, and to enter on any lands adjoining or lying ear the road in order to make such drains or ditches through the same s he may deem necessary for the betterment of the road, doing as little njury to said lands and the timber or improvements thereon as the naure of the case and the public good will permit, and the drains and the litches so made shall be conducted to the nearest ditch, watercourse or waste ground, and shall be kept open by the said superintendent or suervisors, and shall not be obstructed by the owner or occupant of such ands or any other person or persons, under the penalty of forfeiting a um of not less than five dollars nor exceeding ten dollars, or imprisonment or work on the public roads of the county for not less than ten nor xceeding twenty days for each and every offence, said penalty to be colected by the said superintendent or supervisors, if in money and paid ver to the county treasurer and applied to the road fund of the county.

Obtaining timber, stone, gravel, etc., from adjacent unimproved lands.

If the owner of any lands, or the agent or agents of such owner, having in charge lands from which timber, stone, gravel, sand or clay were taken as aforesaid, shall present an account of the same, through the county road superintendent, at any regular meeting of the county commissioners within thirty days after the taking and carrying away of such timber, stone, gravel, sand or clay, it shall be the duty of said commissioners to pay for the same a fair price; and before deciding upon this they may cause to be appointed an impartial jury of three freeholders, one to be selected by the county road superintendent, one by the party claiming damages, and the third to be selected by these two, which jury shall report in writing to the board of commissioners their decision for revision or confirmation: *Provided*, that said land owner or his agent shall have the right of appeal as provided for in section 13 of this act.

Changing location of roads so as to avoid hills, etc.

SEC. 12. That, subject to the approval of the board of county commissioners, the county superintendent of roads is hereby given discretionary power, with the aid of a competent engineer, or surveyor to locate, relocate or change any part of any public road where, in his judgment, such location, relocation or change will prove advantageous to public travel. That when any person or persons on whose lands the new road or part of the road is to be located claims damages, therefor, and within thirty days petitions the board of county commissioners for a jury to assess the damages, the said commissioners, within not less than fifteen nor more than sixty days after the completion of said road, shall order said jury of three disinterested freeholders to be summoned by the sheriff or constable, as provided by law, who shall give said land owners or their local representative forty-eight hours notice of the time and place, when and where said jury will meet to assess damages; and said jury, being duly sworn, in considering the question of damages, shall also take into consideration the benefits to public travel and to the owner of the land, and if said benefits be considered equal to or greater than the damages sustained the jury shall so declare; and it shall report in writing its finding to the board of county commissioners for confirmation or revision: *Provided*, that if said land owner be a non-resident of the county and have no local representative, it shall be deemed sufficient service of such notice for said sheriff or constable to forward by United States mail a written notice of the purpose, time and place of such meeting of said jury, to the last known post-office address of such land owner, seven days in advance of such meeting; and also to post a notice of the same for seven days at the court-house door of said county

Right of appeal.

SEC. 13. That in case the land owner or his local representative shall be dissatisfied with the finding of the juries provided for in sections 11 and 12 of this act, and with the decision of the county commissioners, such dissatisfied party may appeal from the decision of the county commissioners to the superior court of the county; all such appeals being governed by the law regulating appeals from the courts of justices of the peace; and the same shall be heard *de novo;* but the judge may, in his discretion, require said land owner to give bond when the case is taken by appeal to the superior court.

SEC. 14. That any officer or employee [appointed] by virtue of this act, or to whom duties are assigned in this act, who shall fail to make complete returns within the time prescribed therein, or who shall otherwise fail to discharge the duties imposed upon him by this act shall in all cases, whether penalties for such failure are or are not prescribed in this act, be guilty of a misdemeanor.

County treasurer, also treasurer of the several township road funds.

Payments of accounts for road work.

SEC. 15. That the county treasurer shall be, and he is hereby appointed, treasurer of the road fund of the county and of the several townships in the same, and for the faithful keeping and disbursing of said money, the bond of such treasurer shall be liable, and for his services in receiving and disbursing such funds he shall receive such a commission as the board of county commissioners may agree upon, not to exceed two per cent, on all moneys disbursed hereunder. He shall pay the accounts against the road fund of the county and of the several townships when itemized statements of the same have been certified to by the county road superintendent and approved by the board of county commissioners.

SEC. 16. The county treasurer shall keep a separate account of the road fund of the county and of each of the several townships therein, and of his disbursements of the same, and he shall make a written report thereof to the board of county commissioners, at their regular meetings on the first Monday in each month; and on the first Monday in July and January of each and every year, he shall present to the said board of commissioners a written report, giving a statement of the disbursements from the several road funds during the preceding six months, which reports, or the substance thereof shall be published by said commissioners in at least one newspaper published at the county-seat, for at least one insertion.

Inventory and settlement.

SEC. 17. All road funds or securities in the hands of any officer of any county coming under the provisions of this act, or of any township thereof, on the first Monday of June, 1899, shall be promptly turned over to the treasurer of the county, and by him credited to the road funds of the county or of the township to which it belongs; and all teams, machinery, implements, or other equipments belonging to said county or any one of the several townships in the same, held by or under the control of any officers or persons in said county or its townships shall be by said officers or persons turned over to the county commissioners of such county on the first Monday in June, 1899, and by them be held and used on the public roads of the county or of the township owning the same: *Provided*, that the board of commissioners in any county may order such road funds, securities, teams, implements or other road equipment, accounted for and turned over as required above, at any date prior to its regular meeting in June; and officers or persons refusing or neglecting so to do, after having been served with ten days' written notice, shall be guilty of a misdemeanor.

Gradual reduction in number of days for road labor.

SEC. 18. The board of commissioners in any county coming under the provisions of this act, in which the tax for road purposes in the county or any township thereof at the time is not less than 10 cents on the $100 worth of property, may, at its discretion, at its regular meeting in Januory, 1900, or at any regular January meeting thereafter, reduce the number of days of labor required for road purposes in any such county or township thereof in section 4 of this act, such reduction not to exceed one day during any year, reducing also in each case the money to be paid in lieu of such labor at the rate of 50 cents for each day: *Provided*, that for each such reduction in the labor requirement the said board of commissioners shall, at its regular meeting in June next following each such reduction, increase the tax levy for road purposes provided for in section 1 of this act by the amount of 2½ cents on each $100 worth of property and 7 cents on the poll.

Reduction of money in lieu of four days' labor to one dollar.

SEC. 19. The board of commissioners in any county coming under the provisions of this act in which the moneys expended for road improvement in the county or any township thereof exceeds an amount equivalent to the tax levy of 12 cents on the $100 worth of property and 36 on the poll, may, at the discretion of said board, reduce the money requirement in lieu of the four days' labor on the roads provided for in section 4 of this act in such county or township thereof to one dollar for each year.

SEC. 20. In any county coming under the provisions of this act which appropriates annually for road purposes moneys derived from the sale of bonds, or from other taxes, not less in amount than the income from a tax levy of 10 cents on the $100 worth of property in such county, the commissioners in said county shall not, while continuing such appropriation, be required to levy the special road tax provided for in section 1 of this act.

Additional township road tax.

SEC. 21. When in any township in any county coming under the provisions of this Act, a petition is presented to the board of county commissioners, signed by a majority of the land owners of said township, asking that in that township an additional special tax be levied for road purposes, or when in any such township, an election being held in accordance with the laws of this state, and the majority of the votes cast at said election being in favor of such special tax, the county commissioners in such county shall, at their next regular June meeting, levy in such township such additional special road tax as they have been requested to levy by said petition or vote, said tax to be levied and collected as provided for other road taxes in section one of this act; and such taxes shall be added to the township road fund of the township in which it is paid and shall be used only on the roads in that township, under the direction of the board of county commissioners, or under the direction of the three township road commissioners named in said petition or vote, if such be named.

Applies to certain counties.

SEC. 22. This act shall apply to the counties of Mecklenburg (excepting sections 4, 5, 6 and 7), Forsyth (excepting sections 4, 5, 6 and 7), Alamance, Rockingham, Gaston, Orange (for Chapel Hill township only), Durham, New Hanover, Pender, Warren: *Provided*, that as applied to the counties of Durham, Mecklenburg, Forsyth, Alamance, Rockingham and Orange (for chapel Hill township), Warren, the word "may" where it first occurs in section 10 of this act be stricken out and the word "shall" inserted in lieu thereof.

May be adopted for other counties.

SEC. 23. In the counties named below in this section, this act may become the road law in each such county, or any township thereof, when adopted as such by the board of county commissioners at any regular meeting, after being requested to do so by petition signed by three hundred (300) freeholders of the county or fifty (50) freeholders of the township; and when so adopted for any such county or township, it shall be the road law for such county or township, and all other laws in conflict with this act, as applied to such county or township shall be then and thereby repealed or suspended during such time as this law may remain in force: Alexander, Granville, Nash, Beaufort, Greene, Northampton, Bertie, Brunswick, Bladen, Caldwell, Catawba, Chatham, Cleveland, Currituck, Edgecombe, Franklin, Halifax, Hyde, Johnston, Jones, Lenoir, Lincoln, McDowell, Moore, Orange (excepting Chapel Hill township), Pamlico, Pasquotank, Perquimans, Rowan, Richmond, Polk, Stanly, Swain, Vance, Washington, Yadkin, Wilson, Jackson, Tyrrell.

Durham county.

SEC. 24. In this act as applied to Durham county, the services of the road superintendent as provided for in section 2, and of the guards as provided for in section 3 of this act, shall be paid for out of the general county fund; and the moneys raised under section 1 of this act in each township shall be expended in the townships paying the same: *Provided*, that the road tax paid in the county by the building and loan associations, railroad, express, telegraph and telephone companies, and like corporations, shall be used for permanent road improvement in the county in such manner as the board of county commissioners may in its judgment deem best, and *Provided further* that in section 4 of this act lines 2 and 3 the clause "except residents of incorporated towns and cities" shall read "except those who reside within the corporate limits of the town of Durham."

Pender county.

SEC. 25. That in this act as applied to Pender county, C. P. More, A. B. Croom and F. P. Flinn of said county shall be and the same are hereby constituted a board of road commissioners for Pender county; vacancies in said board to be filled by the board of county commissioners; members of said road commission to be paid a sum not exceeding $1.50 each per day, while actually engaged in the necessary work of the commission, for not more than three days during any one month; and the said road commission is hereby vested with all the duties, rights and powers (except that of levying taxes) otherwise in this act conferred upon the county commissioners; and the county commissioners shall levy such tax under section 1 of this act as may be recommended by the said road commission, when petitioned to do so by ten responsible freeholders from each of at least six townships in the county.

Chapel Hill township.

SEC. 26. That in this act as applied to Chapel Hill township in Orange county, G. E. Donnell, W. F. Cole and J. A. Holmes of said township, shall be and the same are hereby constituted a special road commission for said township, which road commission, in carrying out the provisions of this act as applied to said township, is hereby vested with all the duties, rights and powers (except that of levying taxes) otherwise in this act conferred upon the county commissioners. The county commissioners under section 1 of this act shall levy such and only such road tax for Chapel Hill township, within the limits prescribed in section 1 of this act, as may be recommended by said board of road commissioners, and all moneys arising therefrom shall be kept separate by the county treasurer and shall be expended in Chapel Hill township; vacancies on said board of road commissioners shall be filled by the board of county commissioners; and its members shall be paid out of the township road fund, not exceeding $1.00 per day each, while actually engaged in the necessary work of the commission, for not more than three days during any one month. Such moneys as may be paid in lieu of the labor in said township may be collected by the supervisor of roads elected by said road commission and deposited by him for road purposes in such manner, and with such person, and expended as may be designed by the said road commission of the township.

Except section one may be adopted by other counties.

SEC. 27. This act shall not apply to the following counties: Anson, Ashe, Alleghany, Burke, Cabarrus, Camden, Chowan, Cherokee, Craven, Carteret, Clay, Columbus, Cumberland, Dare, Davie, Duplin, Caswell, Graham, Gates, Guilford, Henderson, Harnett, Iredell, Macon, Montgomery, Martin, Madison, Mitchell, Onslow, Pitt, Person, Randolph-Robeson, Rutherford, Sampson, Surry, Transylvania, Wayne, Wilkes, Wake, Union, Watauga, Yancey, Scotland, Hertford, Davidson, Stokes, Haywood, Buncombe:

Provided, that in any county or township not coming under the provisions of this act, but otherwise providing funds for road improvement, the commissioners of such county may at any regular meeting, at their discretion, adopt any of the sections (except section one levying a tax) of this act that in their judgment may be specially adapted to the needs of their county and incorporate the same in the road law of the said county.

Does not interfere with existing township system.

SEC. 28. That all laws and parts of laws in conflict with this act are hereby repealed: *Provided*, that nothing in this act shall be understood or construed as in any way interfering with any existing system of township road work in any township already levying a township tax for road purposes, in any county coming under the provisions of this act.

SEC. 29. That this act shall be in force from and after its ratification.

In the General Assembly read three times and ratified this, the 7th day of March, A. D. 1899.

FORM OF PETITION REQUESTING THE ADOPTION OF THE GENERAL ROAD LAW.

The following may serve as a suggestion in the way of the general form of petition to be presented to the county commissioners asking them to adopt this road law as provided for under section 23 of the same:

We the undersigned freeholders of ---------------------county* respectfully petition the honorable Board of Commissioners of this county at their next regular meeting to adopt the general road law entitled, "An act to provide for the better working of the public roads and highways of the State," enacted by the General Assembly of 1899, as the road law for this county. †

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* Or township of the county of ----------, in case it is desired to adopt the law for some special township and not for the county as a whole.

† Or township, as the case may be.

THE WIDE-TIRE LAW.

ADVANTAGES OF WIDE TIRES.

The benefits resulting from the use of wide tires on wagons and other vehicles are two fold:

1. By the rolling and packing effect of these wide tires the road surface is made smooth and even, instead of being cut into deep ruts, as is the case in the use of narrow tires. Thus a wagon with tires six inches wide will pack twelve inches of road surface every time it passes along; a wagon with tires 1½ inches wide would pack only three inches of road surface; and if we adopt a practice similar to that followed in Europe of having the front and rear axels of different lengths, the wagon with six-inch tires would roll and pack twenty-four inches of road surface. Thus the wide tire not only prevents a road surface from being cut to pieces but it also smooths the surface so as to make it much better for travelling. Even in the case of macadam roads where the surface is more or less hard and firm the narrow tire tends to crush the rock and wear the surface into ruts; whereas the wide tire tends to pack and make smooth this surface.

2. As a rule where the wide tires are used heavier loads can be pulled or the same loads pulled more easily, even taking the road surfaces as they exist, than with narrow tired wagons; and when it is remembered that the wide tire makes a road surface more smooth and even it will be more readily understood that still larger loads can be pulled in any wagon on roads which have thus been packed by wide tires than in the same wagon on another road which has been cut up through the use of narrow tires.

The use of these wide tires on all draft vehicles and even on spring vehicles in European countries is almost universal. It has there been a long recognized fact that the use of such tires is not only better for the team but also better for the roads. This practice of using wide tires is now being introduced in many portions of our own country, and on roads of all descriptions—sandy roads, clay roads and macadam roads. The practice is proving beneficial.

The following statement gives some of the more striking results obtained from an elaborate series of experiments comparing the loads that can be hauled on wide and narrow tired wagons, by the Missouri Agricultural Experiment Station:

On Macadam roads an average of 26 per cent. in favor of wide tires.
On gravel roads 26 to 45 per cent. in favor of wide tires.
On ordinary dirt roads 22 to 71 per cent. in favor of wide tires.
On ordinary meadow lands 22 to 84 per cent. in favor of wide tires.
On pasture lands 26 to 89 per cent. in favor of wide tires.
On stubble lands 34 to 72 per cent. in favor of wide tires.
On plowed ground 33 to 44 per cent. in favor of wide tires.
On clay road with deep mud and deep ruts 10 to 49 per cent. in favor of narrow tires. But with the general introduction of wide tires this condition of things (deep mud and deep ruts) would not exist.

The results of these tests, and indeed the whole question of the use of wide tires, is discussed more fully in Bulletin 18 on Road Building in North Carolina, published by the North Carolina Geological Survey, copies of which can be had by application at the Survey office.

THE TEXT OF THE WIDE-TIRE LAW

is given on the following page.

AN ACT TO PROVIDE FOR THE IMPROVEMENT AND PROTECTION OF THE PUBLIC ROADS OF THE STATE, THROUGH THE USE OF WIDE TIRES ON WAGONS AND OTHER DRAFT VEHICLES.

WHEREAS, The use of wide-tired vehicles on the public roads of the State, as shown by experience, will both benefit and protect these roads by packing and smoothing the surface of the same;

The General Assembly of North Carolina do enact:

SECTION 1. That every person, firm or corporation in the State who, during the year ending December thirty-first, 1899, and each succeeding year thereafter, owns and uses on the public roads of the State any wagon or other draft vehicles with tires as wide as the standard wide-tire wheels described in section 2 of this act, shall on the presentation of proof thereof, satisfactory to the Commissioners of any county in which said wide-tire vehicles are used, be paid by the county treasurer of such county, out of the road fund of the county or township in which the same is used, each and every year, for a period of five years, a sum equal to one-half his or her road tax: Provided, that in no case shall the amount so paid for any year be greater than two dollars on one such vehicle, nor in any case shall the total amount paid to any one person, firm or corporation exceed the sum of five dollars during any one year; and Provided, further, that in case any such person pays no road tax, he shall during each and every year, for a period of five years, be exempt from one-half of the labor which under the law he may otherwise be required to expend on the public roads of the county or township in which he resides.

SEC. 2. For the purposes of his Act, the standard for wide-tire wagons and other draft vehicles shall be as follows: For a *one-horse vehicle* (with skeins 2½ by 8 inches or under, or spindles 1⅜ by 7 inches or under) two and one-half (2½) inch tires; for *two-horse vehicles* (with skeins larger than 2½ by 8 inches, not over 3 by 9 inches, or with spindles more than 1⅜ by 7 inches, and not over 1¾ by 10 inches) four inch tires; and for all vehicles with skeins and spindles larger than the above, six-inch tires.

SEC. 3. This act shall only apply to the following counties: Alamance, Edgecombe, Lincoln, Mecklenburg, Moore, Orange (for Chapel Hill Township only), New Hanover, Rowan, Wilson, Durham and Granville.

SEC. 4. This act shall be in force from and after its ratification.

Ratified this, the 7th day of March, 1899.

It is advisable to use 6-inch tires even on two-horse wagons.

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THE NORTH CAROLINA GEOLOGICAL SURVEY

Economic Papers, No. 3

TALC AND PYROPHYLLITE DEPOSITS

IN

NORTH CAROLINA

BY

JOSEPH HYDE PRATT

MINERALOGIST

RALEIGH
E. M. UZZELL, PUBLIC PRINTER AND BINDER
1900

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BOARD OF MANAGERS.

Governor D. L. Russell, *ex officio Chairman*	Raleigh.
Charles McNamee	Biltmore.
J. Turner Morehead	Leaksville.

J. A. Holmes, State Geologist	Chapel Hill.

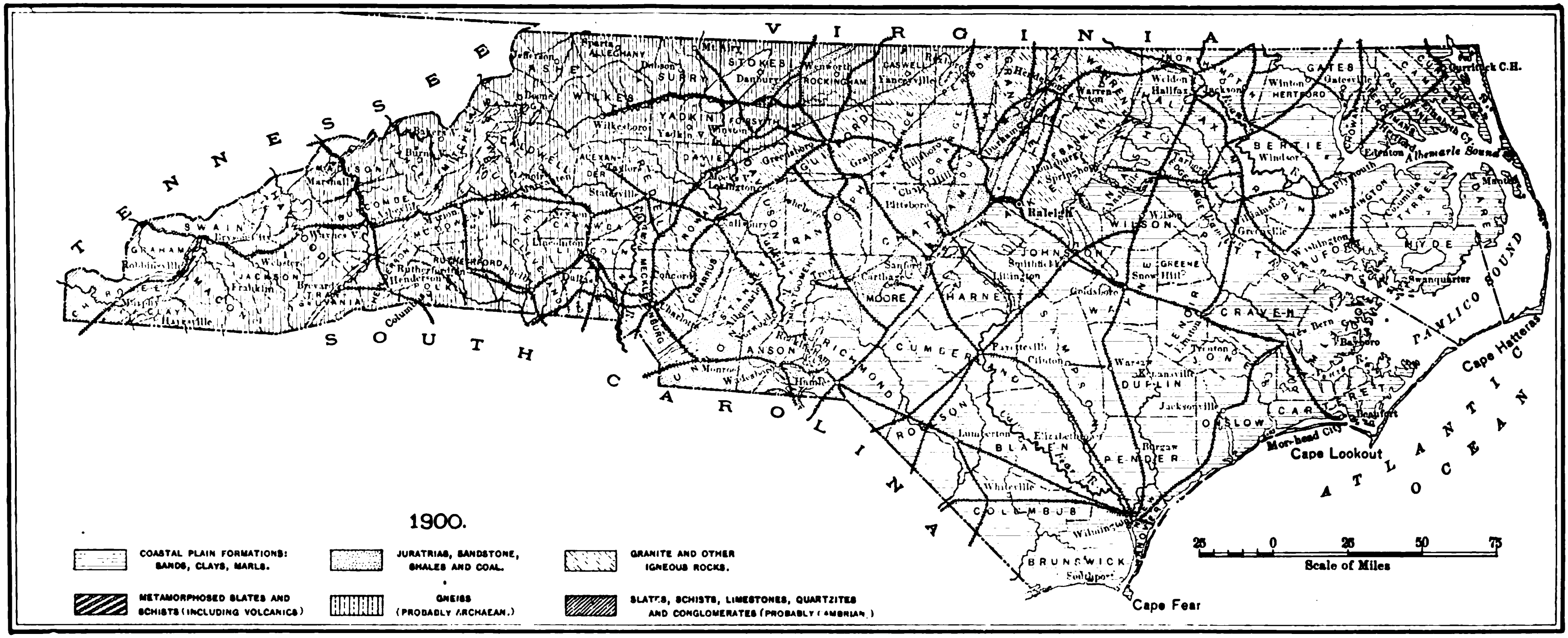
LETTER OF TRANSMITTAL.

RALEIGH, N. C., March 1st, 1900.

To His Excellency, HON. D. L. RUSSELL,
Governor of North Carolina.

SIR:—I have the honor to submit for publication, as the third of a series of economic papers, a special report on the *talc and pyrophyllite deposits* in North Carolina. It has been prepared in response to the numerous applications received at this office for information concerning the nature, extent, location and development of these deposits.

Yours obediently,
J. A. HOLMES,
State Geologist.


VIRGINIA
TENNESSEE
SOUTH CAROLINA
ATLANTIC OCEAN
PAMLICO SOUND
Albemarle Sound
Cape Hatteras
Cape Lookout
Cape Fear
Raleigh
1900.
25 0 25 50 75
Scale of Miles
COASTAL PLAIN FORMATIONS: SANDS, CLAYS, MARLS.
JURATRIAS, SANDSTONE, SHALES AND COAL.
GRANITE AND OTHER IGNEOUS ROCKS.
METAMORPHOSED SLATES AND SCHISTS (INCLUDING VOLCANICS)
GNEISS (PROBABLY ARCHAEAN.)
SLATES, SCHISTS, LIMESTONES, QUARTZITES AND CONGLOMERATES (PROBABLY CAMBRIAN.)

SKETCH MAP OF NORTH CAROLINA SHOWING THE DISTRIBUTION OF THE PRINCIPAL GEOLOGICAL FORMATIONS.

TALC AND PYROPHYLLITE DEPOSITS IN NORTH CAROLINA.

BY JOSEPH HYDE PRATT.

INTRODUCTION.

The North Carolina talc deposits are at the present time attracting more attention than ever before, for the reason, that known workable deposits of this mineral suitable for making into flour-talc are becoming rare; and that many of the known deposits in the United States that have been supplying the market with talc are becoming exhausted. It is essential then that either a new source of supply or a substitute for this mineral be found.

The properties of talc that make it suitable for the purposes for which it is used, are its extreme softness, being *one* in the scale of hardness, and one of the softest minerals known; its purity, or freedom from grit; its stability; and its smooth slippery touch. The mineral that most closely approximates these properties and is known to occur in quantity is pyrophyllite, and it has been used, to a limited extent, as a substitute for talc. There is no reason, as far as the physical properties are concerned, why pyrophyllite should not be mined as extensively as the known deposits will permit, to be used for the same purposes as talc, with the exception of making into pencils, it not being compact enough for this.

Both the talc and pyrophyllite deposits of North Carolina have been known for over forty years, but their development has only been possible as railroad facilities have come into their vicinity. Now, however, all these deposits are within two and a half miles of shipping points on the railroad, and are being thoroughly prospected.

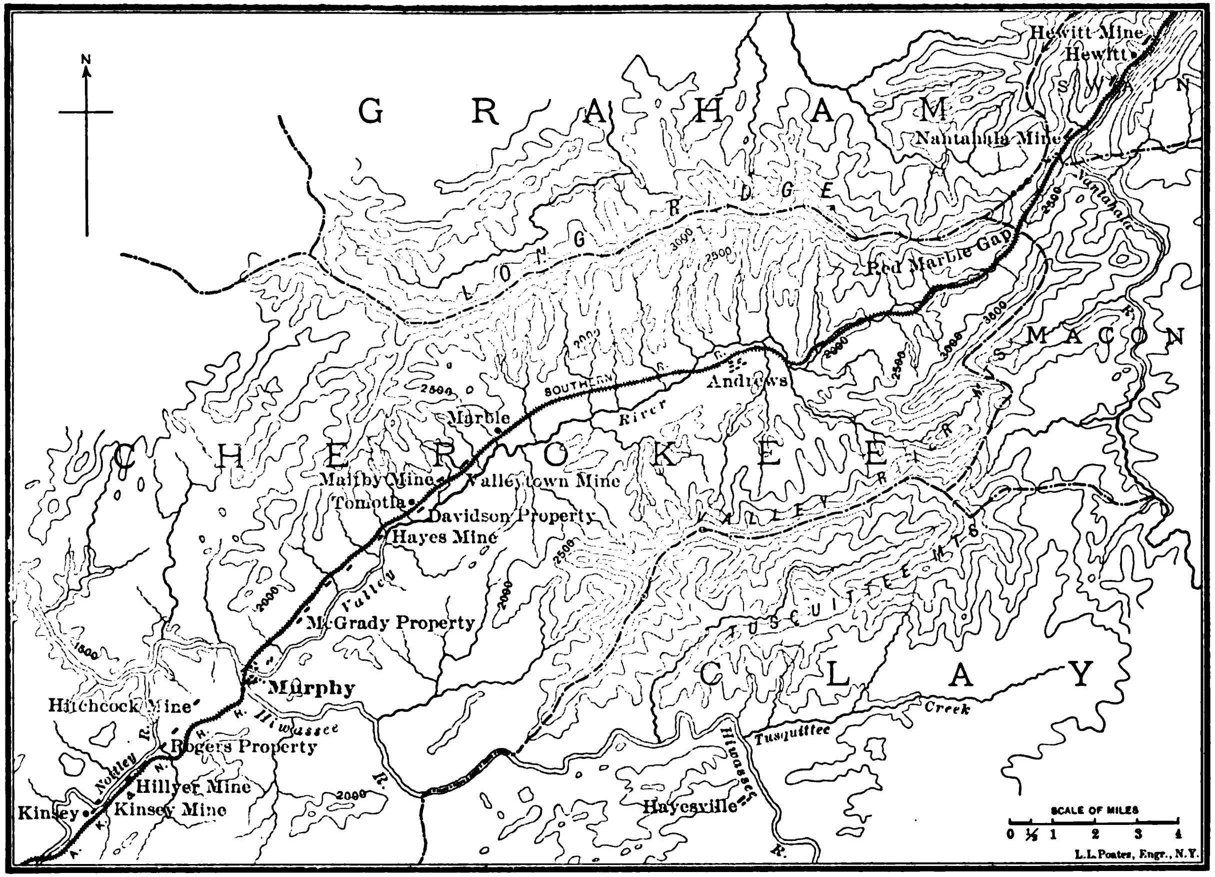
TALC DEPOSITS IN NORTH CAROLINA.

In considering the talc deposits in North Carolina only those are discussed in this paper in which the mineral is suitable for grinding to a powder (flour-talc) or cutting into pencils, and where it occurs in sufficient quantity to permit of its being mined for commercial purposes. While ordinary soapstone is a talc, it is apt to be harder than the foliated variety and to be more or less impure and cannot be used for the above purposes, and for this reason it is not considered in this paper.

Talc suitable for grinding is either foliated talc, which consists of foliæ that are usually easily separated; fibrous, with a more or less silky lustre; or steatite, fine granular to cryptocrystalline; and it must be free from grit. It varies in color from pale green, greenish-white to bluish-white to white. It should not exceed one in hardness.

Talc is a very common mineral, and in small quantity it is widely distributed. It is commonly formed by the alteration of other magnesium minerals, and thus it is an almost constant associate with the peridotite and pyroxenite rocks, with serpentine and with many of the chlorite schists. Beautiful specimens of talc are to be found in nearly all of the peridotite rocks of the State, but no where has this alteration product of the peridotite been found in sufficient quantity to be of any economic importance. Many of the chlorite (talcose) schists contain a large percentage of talc, but the harder minerals associated with it prevents its being of any commercial value. Most of the commercial deposits of talc have been formed from the alteration of other minerals in place. Among the commoner minerals from which it has been derived are tremolite, actinolite and pyroxene.

The only deposits of talc in quantity that are known at the present time in this State are in Swain and Cherokee counties. It was first mined about 1859, when a small amount was being used as linings for the copper furnaces at Ducktown, Tenn. Mr. A. A. Campbell, of Murphy, N. C., was the pioneer of talc mining in this State, and long before the railroads in that section were constructed he was mining and shipping it by wagon to Cleveland, Tenn. With the price of talc at eighty dollars per ton there was a profit even when it had to be hauled this distance. As the price dropped, its mining became unprofitable, until the railroad entered this region; then talc mining was revived.



MAP SHOWING THE DISTRIBUTION OF TALC DEPOSITS (▬) IN PORTIONS OF SWAIN AND CHEROKEE COUNTIES.
The figures 2,000, 2,500, etc., on the contour lines indicate elevations above sea-level.

GEOLOGY AND DISTRIBUTION.

The accompaning map, which has been compiled from the Cherokee and Nantahala topographical sheets of the U. S. Geological Survey, gives in detail the topography of this section of the State and the general location of the talc deposits. The contour lines are at intervals of five hundred feet. (See page 9).

As is shown by this map, the talc formation beginning in Swain county about six miles east of the Valley River mountains, follows up the valley of the Nantahala river to near the Macon county line, then up the Nelson creek ravine and crosses the mountains at an altitude of 2,800 feet at Red Marble Gap. Entering Cherokee county, it then follows down the valley of Valley river, broadening out near Andrews to a width of about one-half a mile; crosses the Valley river and the Hiawasse river and valley in the vicinity of Murphy and follows up the Nottley river valley. The formation crosses the State line into Georgia, but no talc deposits suitable for grinding into flour-talc have as yet been found in that State.

All the deposits are located either along side of the railroad or in close proximity to it. The Murphy branch of the Southern railroad passes over the formation for almost the entire distance from its eastern end to Murphy. To the west of Murphy the Atlanta, Knoxville and Northern railroad follows close to the talc and marble outcrops. Facilities for railway transportation at nearly all the deposits are of the best, and but little hauling by wagon is necessary, two miles being the longest distance from a shipping point on the railroad.

The rocks of the talc-bearing region in these southwestern counties are for the most part marble and quartzite, bordered by gneiss and crystalline schists. Repeated dynamic movements have twisted and folded the strata to such an extent that their original structure has been almost wholly obliterated, and in many cases it has changed considerably their mineralogical character. Part of the limestone has been metamorphosed and recrystallized into compact marbles of the finest quality, while the sandstone has been converted into a quartzite, which at times is almost without perceptible granular structure.

As far as these beds of marble have been examined they are for the most part free from layers of silicates or quartz, except of course those in proximity to its contact with the quartzite. Near the contact, but in the marble, tremolite of a nearly pure white color and in prismatic crystals up to a quarter of an inch in diameter has been found. The limestones which were first laid down and subsequently covered by the sandstone, from which the marble and quartzite are the final results, can be traced from about a mile east of Hewitt, Swain county, in a southwest direction across Swain, Macon and Cherokee counties into Georgia. The width of this marble belt varies from a few hundred yards to over half a mile as along Valley river near Andrews, Cherokee county. The Valley River mountain ridge, the boundary between Macon and Cherokee counties, is an anticlinal fold, with a N. W.–S. E. trend which marks rather sharply in some respects the character of certain formations to the northeast from those to the southwest. To the east of this ridge the marble-quartzite formation is bounded on the south and north by a slate, while to the west of this ridge this formation is bounded on the south by crystalline schists and slates on top of which are numerous beds of limonite iron ore. To the east of the ridge there are apparently no deposits of limonite. The depth of the stratum of marble has not been determined, but it is known to be over 100 feet.

The strata dip at all angles, due to its being repeatedly folded, but has a general trend of about N. 35° E.

It is in connection with this marble formation that the deposits of talc occur. What was formerly supposed to be a regular vein of the talc was probably a series of pockets of this mineral of varying thickness, lying for the most part directly between the marble and the quartzite, although at times they are entirely enclosed by the marble. None, however, have been observed that were enclosed by the quartzite. These pockets, which resemble in shape flattened lenses, always follow the dip of the strata in which they occur, and are therefore encountered in all positions from horizontal to vertical.

These pockets of talc were once much more abundant than they are now observed. At the present time the only evidence as to the former existence of many of these is the occurrence of a bluish clay containing a few scattered flakes of talc. Wherever the quartzite capping of the pocket of talc has remained the talc is in a good state of preservation; but, on the other hand, wherever the quartzite has been removed by disintegration and erosion the talc has been either partially or wholly decomposed into the bluish clay. In places the talc is found wholly surrounded by the marble as at the Kinsey mine, where small pockets or lenses of the talc are in the marble but still close to the contact.

The beds of limonite iron ore are found closely associated with the marble and talc deposits between the Valley River mountains and the Nottley valley. The iron ore which always lies to the south of the talc is sometimes almost in direct contact with it. The yellow stains observed upon so much of the talc in this region is undoubtedly due to its proximity to the iron ore. Although there are a number of iron ore deposits in the Nottley river valley, they are not in close proximity to the talc and marble, and have exerted but little influence upon the character of the talc. It is in this valley that the most beautiful talc has been found.

Folding and subsequent erosion of the strata have brought the marble and talc to the surface at a number of points along these valleys of the Nottley and Valley rivers, and on the slopes of some of the adjacent ridges. In the broader portions of the valleys they are often covered by an alluvial soil which in places reaches a depth of from twenty to thirty feet.

ORIGIN OF THE TALC.

As is well known, there are many minerals which under favorable conditions yield talc as an alteration product; of these the most common being pyroxenes, amphiboles and certain of the micas. Tremolite is one of the amphiboles that commonly yields talc as an alteration product, and in connection with these talc deposits of Cherokee and Swain counties, it is the author's opinion that they are the result of the alteration of former deposits of tremolite.

There are a number of reasons which have led to these conclusions. In many of the marbles along the contact of the talc there are small branches of radiating crystals of tremolite, while in others there are similar crystals which are entirely altered to talc. Also at a number of places, as at the Maltby mine and on the property of the Cherokee Iron, Marble and Talc Co., talc has been found at the contact of the marble which had branching through it many crystals of tremolite. In examining the structure of the talc it is found to be decidedly fibrous, although this is not always apparent in the large masses. When these masses are crushed and examined with the magnifying glass in many cases they are seen to be made up of small fibers. Even the compact talc is observed to have more or less of a fibrous structure when crushed and examined with the higher power microscope. But very little of what could be called a foliated talc has been seen. Tremolite is the only mineral that I have found associated with the talc, except of course the calcite of the marble and the quartz of the quartzite. Except where tremolite has been observed in the talc, the latter is generally free from grit.

CHARACTER OF THE TALC.

There is a decided difference in the character of the talc to the east of the Red Marble gap region from that to the west. It is more compact and of a bluish-white to white color, and a considerable portion of it is suitable for cutting into pencils; while that to the west, of a pale greenish to white to bluish-white color, is more fibrous to foliated, although this characteristic is sometimes not very distinct in the mass, and but little of it is suitable for cutting into pencils. The fibrous structure, which at times is almost a bladed prismatic one, is sometimes very marked, especially in the talc that is found penetrating into the marble. When the talc is crushed and examined under the microscope or magnifying glass the fibrous structure is very pronounced.

Some of the talc found at the Kinsey and Hillyer mines, four and five miles southwest of Murphy, is translucent to transparent and is the finest quality that I have ever seen. All the talc, except when stained with iron and of the dark bluish colors, grinds to a white flour, which is free from grit.

A considerable quantity of the talc is unfit for grinding to a flour on account of its being very badly discolored by iron oxide, or having a great many tremolite crystals penetrating through it in all directions. This is observed more generally in the talc that is found in the valley of Valley river.

The following analyses* have been made of the talc from the Kinsey mine (No. 1), representing the extreme western end of the formation; from the Hewitt mine (No. 2), representing the eastern end, and from the Maltby mine (No. 3), near the middle of the formation:

ANALYSES OF TALC:

	Kinsey Mine. (1)	Hewitt Mine. (2)	Maltby Mine. (3)	Theoretical Composition of Talc.
Water (loss on ignition), H_2O	4.36	5.10	6.14	4.76
Silica, SiO_2	63.07	61.35	56.80	63.49
Alumina, Al_2O_3	1.56	4.42	9.06	
Ferrous Oxide, FeO	0.67	1.68	1.84	
Lime, CaO	0.30	0.82	1.40	
Magnesia, MgO	28.76	26.03	23.98	31.75
Soda, Na_2O	0.79	0.62	0.72	
Potash, K_2O	Trace	Trace	Trace	
Total	99.51	100.07	99.95	100.00

In the above analyses the samples taken were of the best quality from each locality and, as is shown by analysis (1), that from the Kinsey mine approaches closely to a chemically pure talc.

Thus far no use has been made of the talc that is unsuitable for grinding to a flour, which in some cases amounts to a considerable per cent. of the output of the mine, and it would be of great advantage if this waste material could be utilized. There are good reasons for believing that this can be used in the manufacture of a fire-brick, and if experiments that are now being made show this to be practicable, this waste talc could be used where produced, for there are beds of good clay in the immediate vicinity.

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*By Dr. Charles Baskerville, University of North Carolina.

MINING AND CLEANING.

The mining of the talc does not present any serious problems, as the deposits do not extend to any great depth. Those in the low lands of the valley have to contend against water, which occasionally causes considerable loss of time. Most of the mines thus located have been worked by means of open pits, which during a period of rain have to be abandoned owing to flooding. While some of these deposits, especially those on the hillsides, can be worked to advantage by an open pit, the majority of them can best be worked by shafts and tunnels, leaving one shaft as a pumping shaft and draining all the water from the others and the tunnels to this one. By using a series of tunnels one above the other the mine is kept as dry as it is practically possible.

At the Hewitt and Kinsey mines, from the nature of their location, the work has been successfully done by open cuts and tunnels. But little blasting is necessary at any of the mines, as the width of the deposit is usually sufficient for open cuts or tunnels without interfering to any great extent with the harder wall rocks.

As the rough blocks of talc are taken from the mine they are hand-cobbed, if necessary, and sorted into three grades. The larger pieces are cleaned by rubbing them with steel brushes, and the smaller ones by an ordinary founder's scouring machine. They are then dried by being spread over a floor of steam-pipes which are kept at a temperature of about 212° F. When dry, the pieces are crushed and ground and the foreign material removed by seiving. It is then further ground and the product passed through bolting-cloth, making the final product of nearly uniform grain. In grinding or pulverizing the talc a buhr-stone mill is used, the same as in grinding wheat. The ground product is handled very much like flour, and in filling the bags with the flour talc an ordinary flour packer is used.

TALC PROPERTIES BEING DEVELOPED.

North Carolina Talc and Mining Company.—The most important work done east of Red Marble gap is at Hewitt station, by the North Carolina Talc and Mining Company, of which Frank A. Hewitt is manager. The talc deposits here are on the south face of a hill rising almost directly from the Nantahala river. The pocket of talc is resting on a bed of marble, with hanging wall of the same rock and is capped by quartzite. This pocket or bed is almost continuous for nearly 1,500 feet, and includes the adjoining property of the Nantahala Talc and Marble Company. The deposit has been worked for about 500 feet in length by the North Carolina company, and they have cut into the bed of talc to a depth of nearly 40 feet. Other pockets of talc have been opened and extensively mined to the west of this main pocket, but in the same range of hills.

To determine whether there was any considerable depth to the deposit a drill was run into the hill for 95 feet, starting at about 15 feet above the railroad track, which is between the hill and the river. The drill penetrated through marble for the whole distance, which carried it beyond the north wall of the talc, showing that the deposit of the talc had pinched out at that depth. As the bed was worked toward the northeast it widened to 14 feet, making the average width of the deposit about 11 feet. The marble in contact with the talc is dolomitic in character but contains a great deal (42.70 per cent.) of free quartz and tremolite.

A large percentage of the talc mined is of No. 1 quality, only about one-fourth of it being off color, of which a portion is of a rather dark bluish tint. More material suitable for cutting into pencils is obtained from this mine than any of the others.

During the past year (1899) over 900 tons of talc were mined and shipped, of which all but 43 tons were made into flour-talc. Of this about 700 tons was of No. 1 quality. The 43 tons referred to were cut into pencils of various sizes.

There is but very little hauling of the crude talc necessary, as the mill is located at the foot of the hill on the narrow strip of ground between the railroad track and the river. This location also makes it very convenient for shipping the commercial products. The mill has a capacity of 10 tons of flour-talc per day.

Nantahala Talc and Marble Company.—Adjoining the property of the North Carolina Talc and Mining Company on the west is that of the Nantahala company. This company also owns the land adjoining the North Carolina company on the east. The occurrence here is very similar to that at Hewitts, being on the same range of hills rising from the Nantahala river and the property taking in part of the same vein. The talc is of very good quality and considerable of it is compact enough to be cut into pencils. Only a little work has been done here during the past year.

But little mining has been done for talc between these properties just described, on the east, and near Tomotla, on Valley river, Cherokee county, on the west, an intervening distance of about 20 miles. This does not mean, however, that there are no talc beds throughout this distance, but only that the favorable portions for the occurrence of talc in this section of the formation have not been as thoroughly prospected as others. It may be found, as this region is more carefully prospected, that talc beds which may have originally been here have been subsequently altered and removed by erosion.

VALLEYTOWN MINERAL COMPANY.—This company has done a little mining about two miles northeast of Tomotla, or six miles northeast of Murphy, in Cherokee county. About 200 tons of talc were obtained, some of which was badly mixed with tremolite, from a pit close to the railroad. A mill was erected for grinding the talc but it has been closed for nearly a year and no mining has been carried on during that time. From the indications observed here, there is reason to believe that there is a considerable bed of talc on this property.

SOUTHERN MINERAL COMPANY.—Less than a mile to the southwest of the above property is the old Maltby mine, now owned by the Southern Mineral Company, of which D. C. Curtis, of Tomotla, is manager. The work done at this mine consists of a pit approximately 70 feet square, and 10–20 feet deep, cutting across the bed of talc. Near the centre of the pit a shaft 15 feet deep has been sunk, which penetrated the talc and entered a greenish talcose rock which was very gritty. A few feet to the south of the pit two additional shafts have been cut to a depth of 30 feet, the lower ten feet of which penetrated talc. But little work has been done to accurately determine the depth of the talc, but borings have been made at angles of 45°, which penetrated talc for more than 50 feet. The southeast or hanging-wall is a marble and the northwest or foot-wall is a quartzite. The dip of the strata is 5°–10° S. E. A little prospecting has been done in the vicinity of the mine which has showed the presence of pockets of talc which contain a great deal of tremolite. In excavating for the foundation of the mill, talc was uncovered. The marble in contact with the talc is dolomitic in character and carries occasionally crystals of tremolite. As there is no chance to run a cut into the pit all the talc and waste material are hoisted by whim and derrick. It is probable that this mine could be worked more profitably by shafts and tunnels.

Considerable of the talc from this mine is off color and according to the discoloration is classed as No. 2 or No. 3. These lower grades are, however, usually as free from grit as the No. 1 talc. None of the material thus far obtained from this mine is compact enough for cutting into pencils. Mr. Curtis reports that about 1,000 tons of the various grades have been mined, of which a portion was ground, and part shipped in the rough masses as mined. The mill on this property is one of the best equipped of any in the talc region, and has a capacity of 15 tons of flour talc per day.

DAVIDSON PROPERTY.—One mile southwest of the Maltby mine, and at Tomotla, the formation crosses the farm of Winslow Davidson. A few pits have been sunk in the lowlands of Valley river to the southeast of the railroad track and opposite the depot. In a number of these pits talc of good quality was encountered, but no work has been done to demonstrate whether or not it exists in quantity.

HAYES MINE.—This mine is about five miles northeast of Murphy and one mile southwest of Tomotla on the property of J. F. Hayes. On this talc deposit there is an open cut about 60 feet long, 40 feet wide, and 30 feet deep, following down its contact with the marble on the southeast. Tests made by boring show that there is a considerable width and depth of talc at this mine, and test pits made, 50 feet to the southwest and 200 feet to the northeast, indicating that along the strike the pocket extends for some distance.

According to Mr. Hayes, about 1,000 tons have been taken out of this mine in recent years, of which only about twenty-five per cent. was of first grade. The talc was not so badly stained at the lower depth and was freer from grit. No mining has been done during the past year.

Between the Hayes mine and the next property of importance on the west, that of the Cherokee Iron, Marble and Talc Company, there has been but little prospecting, and nothing of importance has been found.

CHEROKEE IRON, MARBLE AND TALC COMPANY.—This company's property, of which Edward McCrady, of Charleston, S. C., is president, extends to within about a mile of Murphy, following along the talc-bearing formation for over two miles. Prospecting was undertaken by means of shafts and pits, and in the latter part of November (1899) by boring with an auger. While this work has shown the presence of a considerable quantity of talc it has not yet shown much of good quality. Mr. A. S. Emerson, of Baltimore, Md., who is mining for talc at the Kinsey mine, has been testing the property by boring holes through the soft material until the solid rock was encountered. Most of the talc found thus far has been mixed with a considerable per cent. of tremolite, and much of it has been badly stained. As prospecting is continued, it is not at all unlikely, but is very probable, that good deposits of talc will be found, free from stains and grit.

HITCHCOCK PROPERTY.—This property, comprising about 2,700 acres, is the first one to the west of Murphy where there has been any prospecting for talc. A number of cuts and small pits have been made at various places which have shown the presence of talc, but for the most part of inferior quality. Systematic boring would be the easiest and quickest way to determine whether there are any deposits of good talc. From the indications shown by the present prospecting, it is not unreasonable to expect that good deposits will be found on this property. The nearest shipping point on the railroad is Murphy, a distance of two miles. This property is now owned by Mrs. Lily Coit, of San Francisco, Cal.

ROGERS PROPERTY.—This adjoins the Hitchcock property on the southwest, and has been prospected to a limited extent, both by pits and borings. No definite information could be had regarding this, but it is reported that good talc was encountered in many of the borings. The property extends for two miles along the marble-talc formation, but more thorough prospecting is necessary before anything definite will be known regarding either the deposits of talc or of marble. The Atlanta, Knoxville and Northern railroad crosses the property.

HILLYER PROPERTY.—This property, including the Hillyer mine, lies to the southwest of the Rogers Tract along the Atlanta, Knoxville and Northern railroad, about four miles southwest of Murphy, and is owned by the Atlanta Talc, Mining and Manufacturing Company, of which Judge George Hillyer, of Atlanta, Ga., is the president.

Mining has been carried on quite extensively at this mine, which is one of the largest and best that is known on the talc formation. Three shafts nearly in a line, with the strike of the rocks and 100 feet apart have been sunk on the bed of talc penetrating this for 27 feet, making a total depth of each shaft about 60 feet. The foot-wall of quartzite is but 16 feet from the shafts, and is dipping nearly 30° to the southeast. The width of the bed is known to be 40 feet, but no tests have been made to determine its actual width or depth. A little to the northwest of the line of shafts and 300 feet to the southeast, a tunnel 100 feet long was run along the quartzite contact and good talc encountered.

This mine has yielded several thousand tons of the finest quality of talc, but practically none of it was compact enough to be used in cutting into pencils. The mine when examined was full of water, so that nothing could be seen of the talc in place, and nothing definite can be said regarding the quantity, but judging from what has been obtained from the mine, and the report of the amount of work done, and from what could be gathered from surface indications, there is a large quantity of good talc still in this mine.

NOTLA MARBLE AND TALC COMPANY.—This company's property is located at and in the vicinity of Kinsey, N. C. The talc deposit is known as the Kinsey Mine, and is being worked by A. S. Emerson, of Baltimore. The larger part of the talc from this mine has been found wholly within the marble, but near the contact of the marble with the quartzite. Two tunnels, one of them having a length of 75 feet, have been run in on the deposit, one ten feet below the other. The talc occurs in a series of rather flat lenses which yield a product of the finest quality, like that obtained from the Hillyer mine. That found at the contact between the marble and the quartzite is not of as good quality as the talc entirely surrounded by the marble. These pockets of talc at the Kinsey mine have been pretty thoroughly worked out, and other portions of the company's lands are now being prospected by borings to locate if possible other deposits. Blocks of talc have been obtained from this mine that have weighed nearly a thousand pounds. A mill connected with this property has a capacity of six tons of flour-talc per day. The railroad passes by the mine and within a very short distance of the mill.

There has been but very little talc found to the southwest of the Kinsey mine, and nothing has been observed that has indicated the existence in that direction of any important deposits of this mineral.

MARBLE ASSOCIATED WITH THE TALC.

Associated with all the talc deposits described above is marble, which in many localities is in such quantity and of such quality as to be of commercial value. The marble varies in color from white to pinkish and bluish. While a great deal of the marble has been too much broken in connection with the folding and general up-lift of the rocks of the region to be available as a building stone, there are however, a number of deposits in which it is of considerable economic importance.

At the present time the only locality that is being worked is at the Kinsey mine, some four miles southwest of Murphy. The marble here is of a pinkish-white and bluish-gray color, and of a uniform texture.

Some of the most promising outcrops of marble are in the valley of Valley river. Of these the one which has shown the most promising prospect is at the Hickerson place, across the river from the railroad depot at Andrews. The deposit here has been tested by means of boring at a number of places, and it was found sufficiently solid and free from cracks to make it suited for building and ornamental purposes. It is white in color, fine grain and compact, and indications seem to show that this can be used as a statuary marble.

Marble outcrops at intervals from the Kinsey to the Hewitt mine, and it is not at all improbable that other deposits of commercial value will be found in connection with this talc belt.

The marble that is in direct contact with the talc deposits is dolomitic in character, as seen by the analyses below. The pink and blue marble found at the Kinsey mine show but a very small per cent. of magnesia. In the following analyses,* Nos. 1, 2 and 3 are of white marble that is in direct contact with the talc at the Kinsey, Maltby and Hewitt mines respectively; No. 4 is of the pink and No. 5 of the blue marble from the Kinsey mine.

ANALYSES OF MARBLE ASSOCIATED WITH TALC DEPOSITS;

	White Marble, Kinsey Mine. (1)	White Marble, Maltby Mine. (2)	White Marble, Hewitt Mine. .(3)	Pink Marble, Kinsey Mine. (4)	Blue Marble, Kinsey Mine. (5)
Insoluble residue.........	5.20	2.10	42.70	2.90	2.80
Lime, CaO.........	28.62	30.14	17.62	49.10	52.30
Magnesia, MgO............	19.27	20.70	11.48	3.67	0.50

In the first three of the above analyses the ratio of the CaO : MgO is as follows:

No. 1, $CaO:MgO=.511:487=1.05:1$.
No. 2, $CaO:MgO=.538:517=1.04:1$.
No. 3, $CaO:MgO=.314:287=1.09:1$.

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* By Dr. Charles Baskerville, University of North Carolina.

These are very close to 1:1, which shows that they represent normal dolomite marbles, and as these analyses are of samples from three points at different places on the formation, they indicate that all the marble in contact with the talc is of the same general character.

The marble from Hewitt's (No. 3) contains a large percentage of impurities which were very apparent in the hand specimen. This, however, graded into a marble that was very free from grit. That from the Maltby mine (No. 2) shows a very pure marble close to the contact, and that from the Kinsey mine (No. 1) does not contain a very large percentage of impurity. The insoluble residue consisted of talc, quartz, and sometimes a little tremolite.

The pink and blue marble from the Kinsey mine (Nos. 4 and 5) are very pure lime marbles, the latter containing but little more than a trace of magnesia.

It is not unreasonable to expect that the near future will see considerable activity in marble quarrying in this section of the State.

PYROPHYLLITE (AGALMATOLITE).

The name agalmatolite properly means a variety of pinite, one of the micas, but it has been loosely used for a variety of minerals, as compact talc (steatite) and compact pyrophyllite. The name was originally used for a soft mineral found in China, which was used for carving into minature images, considerable of which was a genuine pinite, but some of that used was a compact talc and pyrophyllite. Thus the name has been given to talc and pyrophyllite from a number of localities on account of their resemblance to the pinite (agalmatolite) of China.

It is seen from the analyses on page 26, that the so-called agalmatolite from Moore and Chatham counties, North Carolina, is not a pinite but a pyrophyllite. As the name agalmatolite has been so constantly used as a trade name, for the mineral from these counties, it will be given in parentheses after the name pyrophyllite wherever it is necessary to use the name in describing the mineral.

OCCURRENCE OF PYROPHYLLITE IN NORTH CAROLINA.

The pyrophyllite (agalmatolite) deposits are located in the extreme north central portion of Moore and the south central part of Chatham counties, and can be traced across the country for a distance of eight miles. The principal mining that has been done is near the boundary between the two counties in the vicinity of Glendon, Moore county. They are associated with the slates of this region but are not in direct contact with them, being usually separated by bands of silicious and iron breccia, which are probably 100 to 150 feet thick. These bands of breccia contain more or less pyrophyllite, and they merge into a stratum of a pyrophyllite schist. Between this and the massive beds of pure pyrophyllite there are very often small seams of quartz and larger lenticular quartz masses, several feet thick.

The strike of this formation is approximately N. 55°-60° E. and dipping 60°-70° to the northwest. It is first encountered about three and three-fourth miles southwest of C. H. Womble's house, and three and one-fourth miles beyond Deep river. Where the formation crosses the river there is a good outcrop of the pyrophyllite, and then at a point 100 yards to the northeast and extending for about half a mile, the mineral has been mined at intervals. Beyond this point, which is near Rogers creek, there has been no mining, but the formation can be followed for another three miles to the northeast. In this distance there are many promising outcrops of the pyrophyllite, which will probably develope into as good deposits as any that have been heretofore opened.

The beds of this mineral are not entirely of commercial quality, but there are bands of the pyrophyllite that are highly silicious along side of those that are entirely free from grit. Although the general appearance of the waste and good material is very similar, they can readily be distinguished by the touch, and can readily be kept separate by hand cobbing.

Small seams of quartz often penetrate into the beds of pyrophyllite, cutting across the bedding of the formation, while those between this and the brecciated rock or schistose rock are parallel with the strike.

Besides the quartz as an impurity, portions of the deposit are filled with small particles, some of which are chlorite, and others hematite, giving them a decided speckled appearance. These portions vary from seams a few inches in width to lenses several feet thick.

A cross section of these beds will probably not show an average of over twenty-five to thirty per cent. of commercial pyrophyllite.

The pyrophyllite rocks have a width of about 500 feet, but not over 100 feet of this would constitute the workable deposits, and of this but twenty-five per cent. would be of commercial pyrophyllite (agalmatolite). This, however, is so located that not over fifty feet would have to be mined to obtain the twenty-five feet of good number-one material.

While the talc deposits of Cherokee and Swain counties are pockety in nature and of limited depth, the pyrophyllite formation is continuous and of considerable, though of unknown depth.

Since the construction of the railroad from Gulf, Chatham county, to Carthage, Moore county, by the Durham and Charlotte R. R. Company, nearly the whole pyrophyllite formation has been brought into close proximity with railroad facilities, thus making the mining of these deposits a practical proposition.

While possessing many of the physical properties of talc and often being mistaken for it, the pyrophyllite is quite different in its chemical composition, and is a distant mineral species. Although this mineral probably cannot be put to all the uses of talc, it can be used for the larger number of them, and those for which the talc is used in the greatest quantity. Some of this might be of such quality that it could be cut into pencils, but the most of this mineral would only be of value when ground. It is soft with a greasy feel and pearly luster, and has a foliated structure. The color varies from green, greenish and yellowish-white to almost white; but when air-dried they all become nearly white. Very little compact pyrophyllite has been observed that would be suitable for carving, as is used in China, although considerable of this has been used in the manufacture of slate pencils.

Chemically, pyrophyllite is a hydrous aluminum silicate, while talc is a hydrous magnesium silicate. The following analyses* have been made of three samples of this mineral, from the property of the Rogers Creek Mining Company:

ANALYSES OF PYROPHYLLITE (AGALMATOLITE):

PYROPHYLLITE.	Black Variety. (1)	Yellowish-white Variety. (2)	Apple-green Variety. (3)
Water (loss on ignition) H_2O	5.86	5.45	5.85
Silica, SiO_2	61.27	64.53	63.50
Alumina, Al_2O_3	25.66	29.40	28.73
Ferrous Oxide, FeO	5.37	0.67	0.84
Lime, CaO	0.60	Trace	Trace
Magnesia, MgO	Trace	Trace	Trace
Soda, Na_2O	0.83	0.28	0.37
Potash, K_2O	0.11	Trace	Trace
Total	99.70	100.33	99.69

In the above analyses No. 1 represents a black variety of the pyrophyllite, which was apparently free from any grit, and the dark color was undoubtedly due to the large percentage of iron that the mineral contained. The other two analyses are of two samples of the massive mineral of first quality, as it was obtained from the mine, No. 2 being of a yellowish-white and No. 3 of an apple-green color. As is noticed in these analyses the percentage of iron is very low and the composition of the mineral is made up almost entirely of alumina (Al_2O_3), silica (SiO_2), water (H_2O) and only a trace of magnesia.

The ratios of $Al_2O_3:SiO_2:H_2O$ are in 1, $= 1.08:4:1.12$, and in 2, $= 1.08:4:1.24$, which are approximately $1:4:1$, giving the formula H_2O, Al_2O_3, $4\ SiO_2$, the same as for pyrophyllite.

That these pyrophyllite schists and beds of the massive mineral were not steatite, or the genuine agalmatolite was first shown by Prof. George J. Brush,† of Yale University. In 1862 he had specimens of this mineral which was at that time supposed to be talc (soapstone), analyzed in the Sheffield laboratory with the result that they were shown to be identical in composition with pyrophyllite, and that the variation in the pyrognostic properties of the different varieties is entirely due to their structure.

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* By Dr. Charles Baskerville, of the University of North Carolina.

† Am. J. Sci., No. 34, 1862, p. 219.

These deposits have been known for over fifty years but there has been but very little systematic mining, and what material was obtained was used for the same purposes as talc.

The pyrophyllite, after coming from the mine, is cleaned and treated the same as talc, being first dried and then cleaned by brushing, then crushed, seived and passed through bolting-cloth. The ground product is almost identical in appearance with flour-talc, and should bring in the market about the same prices that talc does.

MINING PROPERTIES.

Phillips Property.—Beginning at the southwest portion of the formation, the first locality at which any mining has been done is on the Phillips property, about one and a half miles northwest of Glendon and a third of a mile northeast from Deep river, and extending from 1,200 to 1,500 feet on the pyrophyllite formation.

This property has been opened up at intervals during the past thirty-five years, the last work being done by the White Soapstone Company of New York City. The deposit has been opened along the strike for a distance of about thirty-five yards by a cut varying from ten to twenty feet in width and ten to twenty feet in depth. Near its southwest end there is an additional cut five feet deep by twenty feet wide. Very little good pyrophyllite is in sight at any of the openings on this property; but the indications are that material of good quality will be found if the property is thoroughly developed. No mining has been carried on here for a number of years.

Womble Property.—The property adjoining the Phillips to the northeast is the Womble, which extends along the formation for a distance of 1,200 feet. It is now owned by Mrs. Cora C. Fry, of Glendon; but is controlled and operated by C. H. Womble. Small pits have been sunk at intervals for nearly its entire length, but the mining now being done is at the northeast end of the property

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